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VOL. CXXXV.—No. 3509] LONDON: FRIDAY EVENING, MARCH 30, 1923 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Ministry of Transport.

ROADS DEPARTMENT.

APPLICATIONS are INVITED for a limited number of TEMPORARY APPOINTMENTS as ENGINEERS in connection with new road construction works to be carried out in the vicinity of London. The appointments will carry inclusive salaries at rates between £600 and £700 per annum, according to responsibility and qualifications. Candidates should be Associate Members of the Institution of Civil Engineers or should hold the testamur of the Municipal and County Engineers' Institution or some equivalent or higher professional qualification. Experience in road and bridge construction is essential. Candidates should not be more than 45 years of age and should have served in His Majesty's Forces.

Forms of application can be obtained from the ESTABLISHMENT OFFICER, Ministry of Transport, 6, Whitehall-gardens, S.W. 1. Applications can only be received on the recognised forms and should reach the Ministry of Transport on or before 9th April, 1923. 1977

In the High Court of Justice, Chancery Division, Mr. Justice Astbury. 1922 T. 993.

In the Matter of The SOUTH OF ENGLAND AGRICULTURAL MACHINERY COMPANY Limited and Reduced;

and

In the Matter of The COMPANIES (CONSOLIDATION) ACT, 1908.

Notice is Hereby Given that the Order of the High Court of Justice Chancery Division dated the 19th day of March 1923 CONFIRMING the REDUCTION of the CAPITAL of the above-named Company from £25,000 to £16,180 and the Minute approved by the Court showing with respect to the share capital of the Company as altered the several particulars required by the above Act were registered by the Registrar of Companies on the 23rd day of March 1923. The said Minute is in the words and figures following:—

"The capital of the South of England Agricultural Machinery Company Limited and Reduced is £16,180 divided into 32,360 shares of 10s. each of which 17,640 shares have been issued and are fully paid and 14,720 are unissued instead of £25,000 divided into 25,000 shares of £1 each."

Dated this 24th day of March 1923.

PETER THOMAS and CLARK,
1, Bush-lane, E.C. 4,
Solicitors for the said Company.

1957

The Manchester Steam Users' Association.

The ANNUAL GENERAL MEETING of the Members was held in the Board Room of the Association, at their Offices, 9, Mount-street, Manchester, on Tuesday, March 20th, Harold Lee, Esq., J.P. (Manchester), President, in the chair, when the following resolutions were adopted:—

Moved by the Chairman, seconded by J. T. Brown, Esq., Pendlebury (Vice-President), and resolved:—

"That the Report of the Committee of Management to the Subscribers be adopted."

Moved by John Edward Taylor, Esq. (Messrs. Fletcher Burrows and Co., Ltd., Atherton), seconded by Edward Turnbull, Esq. (Messrs. Tate and Lyle, Ltd., Liverpool), and resolved:—

"That the thanks of the Association are due and are hereby presented to the Committee of Management for their past services, and that the following gentlemen be elected the Committee for the ensuing year, with power to add to their number:—

"COMMITTEE OF MANAGEMENT.

"Harold Lee, Esq., J.P., Manchester.
"A. Norman Dugdale, Esq., J.P., Blackburn.
"Jas. Stanley Addison, Esq., London.
"J. T. Browne, Esq., Pendlebury.
"J. Alfred H. J. Cochrane, Esq., Openshaw.
"Charles W. Crossley, Esq., J.P., Halifax.
"Charles Roberts, Esq., Manchester."

Moved by George H. Burrows, Esq. (Messrs. Pilkington Bros., Ltd., St. Helens), seconded by W. M. Hebblethwaite, Esq. (The British Dyestuffs Corporation (Huddersfield), Ltd., Huddersfield), and resolved:—

"That Messrs. F. W. Popplewell and Son, Chartered Accountants, Manchester, be appointed Auditors of the Association's accounts for the year 1923."

JAMES PARE,
Secretary.

9, Mount-street, Albert-square, Manchester,
March 21st, 1923. 1955

TO ENGINEERS AND SHIPBUILDERS.

The Conservators of the River

Thames invite TENDERS for the CONSTRUCTION and DELIVERY afloat in the Thames at Teddington Lock, Middlesex, of a STEEL SINGLE-SCREW (or alternatively twin-screw) STEAM RIVER TUG of the following overall dimensions, for use on the upper Thames above Teddington:—

Extreme dimensions, 58ft. by 13ft. 6in. by 6ft. 3in. Draught, limited to 4ft. 6in. aft and 4ft. forward in working trim.

Frames, 2½in. by 2½in. by 5-16in., spaced 14in./18in. apart, with reverse frames, 2in. by 2in. by ⅜in., plating 3-8in and 5-16in., plate keel doubled.

Bulwarks of ⅛in. plate, 18in. high, to tumble in.

Decks, 5-16in. chequered plate.

Keelson and side keelsons of ample strength.

Engines, Compound (or triple-expansion) surface condensing, to develop at work at least 150 I.H.P.

Boiler, marine, 8ft. by 8ft., 150 w.p., to pass Board of Trade special survey.

Trimming tanks, fore and aft, and pump for filling and emptying.

Propeller, cast steel, 4ft. 6in. diameter if single screw.

All top hamper to pass under headway of 8ft. 6in. above water line, funnel to be made to lower.

The whole to be of first-class British workmanship and British materials, complete with one cabin, storehouse and usual equipment, and at least equal in all respects to Board of Trade and Lloyd's regulations.

Earliest date when delivery can be effected should be stated.

All inquiries should be addressed to the Chief Engineer at the undermentioned address.

Sealed Tenders, marked "Tender for Tug," accompanied by drawings and full specifications and addressed to the Conservators of the River Thames, 2/3, Norfolk-street, Strand, London, W.C. 2, must be delivered not later than 10 a.m. on Monday, 23rd April, 1923. No Tender after that time will be considered.

The Conservators do not bind themselves to accept the lowest or any Tender.

F. W. GEARY,
Secretary.

Thames Conservancy Offices,
2/3, Norfolk-street,
Strand, London, W.C. 2,
20th March, 1923. 1911

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Coastal Motor Boats in the War.

Chinese Government Railways.

The Early History of the Gas Process

Inchinnan Rolling-Lift Bridge.

Electricity for Agriculture.

Reduction Gearing for Steamships.

A New Steam Road Roller.

A Hydro-Electric Project in Ulster.

PUBLIC NOTICES

Port of London Authority.

The Port of London Authority are prepared to receive TENDERS for LICENCES to WORK FOUR STEAM DREDGERS for raising ballast from the River Thames below Gravesend for a term of three years from the 1st August, 1923.

Copies of instructions to persons tendering, form of Tender, and the conditions relating thereto can be obtained on application to the Chief Engineer, Port of London Authority, Trinity-square, London, E.C. 3.

Tenders will be received until Noon on the 5th May, 1923.

The Authority do not bind themselves to accept the highest or any Tender, and reserve the right to grant any number of such Licences up to four and any number of Licences to dredge sand, gravel, ballast or other substances by hand power anywhere in the River Thames.

F. AYLIFFE,
Secretary.

Port of London Authority,
Trinity-square, E.C. 3. 1957

Tottenham District Council.

TO MANUFACTURERS OF CLINKER CRUSHING AND SCREENING PLANT.

The Council invite TENDERS for certain PLANT in connection with Clinker Crushing at their Destructor Works. This plant is to include CRUSHERS, ELEVATOR, MAGNETIC SEPARATOR, SCREEN, STORAGE BINS, &c. Further particulars may be obtained on application to the Engineer of the Council. Tenders must be delivered to the undersigned in sealed envelopes, endorsed "Tender for Clinker Plant," not later than Twelve Noon on Tuesday, 10th April, 1923.

Dated this 27th day of March, 1923.

REGINALD C. GRAVES,
Clerk and Solicitor of the Council.

Town Hall, Tottenham, N. 15. 2001

The Trustees of the Port of

Karachi invite APPLICATIONS for the POST of EXECUTIVE ENGINEER, from Civil Engineers who have passed the examination for Associate Members of the Institution of Civil Engineers or hold an exempting degree, and who have had good experience on Dock Construction, preferably on a contractor's staff.

Salary Rs. 800 per mensem, rising by annual increment of Rs. 50 per mensem for approved service to a maximum of Rs. 1200 per mensem.

The appointment will be probationary for six months. If confirmed, the applicant will be required to enter into a five years' agreement.

The successful candidate will be granted first-class railway and steamer fares to Karachi.

All officers of the Port Trust are required to join the Port Trust Provident Fund on confirmation, the deduction being 8 1-3 per cent. per mensem. The Board contribute an equal amount and 5½ per cent. interest is allowed on the whole. Leave and leave allowances will be given in accordance with the rules for the time being in force.

Applications, with copies of testimonials and full particulars of parentage, date and place of birth, educational and other qualifications, present employment and previous experience, to be addressed to Messrs. RENDEL, PALMER and TRITTON, 12-14, Dartmouth-street, Westminster, London, S.W. 1, so as to be received not later than the 27th April, 1923. 1978

SITUATIONS OPEN

APPLICANTS for the POST of CHIEF ASSIST. ENGINEER for Water Department of a large Company in London are thanked, and are informed that the POST has now been FILLED. 1964

WANTED.—Several ENGINEERING GRADUATES, preferably with an engineering degree, REQUIRED for Training as Sectional Engineers in a large Chemical Factory in the Midlands. Good prospects for men with scientific knowledge, initiative, and energy.—Address, 1927, The Engineer Office. 1927 A

PUBLIC NOTICES

The Gas Light and Coke Company.

CHIEF DRAUGHTSMAN.

CHIEF DRAUGHTSMAN REQUIRED by the above Company. Candidates must have had first-class technical training and extensive experience in the design of buildings, structural steel work, and plant for the mechanical handling of materials. A knowledge of the construction of gasworks plant and river walls is also desirable.

Applications, giving full information as to experience and qualifications, age, salary required, and endorsed "Chief Draughtsman," should be addressed to the CHIEF ENGINEER, The Gas Light and Coke Company, Horseferry-road, London, S.W. 1, on or before 20th April. 1986

SITUATIONS OPEN (continued)

WANTED, ENGINEER, Expert in Up-to-date Wireless, including Telephony and D.F.; well-educated, possessing thorough training and extensive experience as Mechanical and Electrical Engineer and in I.C. Engines and Compressing Plants; Draughtsman, used to Design of Mechanical and Structural Details; age 29-31. Permanent pensionable appointment. Base rate for 2/3 years £350, equals £504 with present Civil Service bonus, rising to base £500, equals £696 with bonus. Bonus varies with cost of living. Civil engineering experience not required, and amateur wireless no qualification.—Address, 1945, The Engineer Office. 1945 A

WANTED. — Experienced CHEMICAL WORKS ENGINEER REQUIRED for a large Chemical Factory in the Midlands; thoroughly acquainted with the design, construction, and operation of all classes of Chemical Plant.—Address particulars of scientific training, with details of experience, copies of testimonials, salary required, 1926, The Engineer Office. 1926 A

WANTED, First-class MACHINE SHOP INSPECTOR, by large Electrical Manufacturers in the Midlands; one used to viewing and examining the larger machine parts of electrical machines. Only high-grade men with experience in maintaining a high standard of machine shop practice need apply. State age, wages, and experience.—Address, 1967, The Engineer Office. 1967 A

WANTED for Railway in Tropics, DISTRICT LOCOMOTIVE SUPERINTENDENT, thoroughly experienced, young, single, hard-working; salary £500 per annum.—Write, "TROPICS," c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 4. 2000 A

ENGINEER, Thoroughly Qualified, of Good Social standing, with mechanical and civil engineering experience, REQUIRED for healthy part of the East, age 30/35, unmarried. Applicants should have general all-round experience, including drawing-office work. Actual oilfield experience would also be a recommendation. Give fullest details.—Address, P7165, The Engineer Office. P7165 A

ENGINEER, to Take Charge of Large Rolling Mill Plant, maintenance and construction. State age, qualifications, and salary required.—Address, P7168, The Engineer Office. P7168 A

TELEGRAPH OPERATOR MECHANIC REQUIRED, with experience in adjustment and working in quadruplex circuits and good all-round telegraph knowledge, including wiring and installing.—Address, giving details of experience and qualifications, stating salary required, P7181, The Engineer Office. P7181 A

WANTED, SENIOR DRAUGHTSMAN, with First-class experience in the Design of Aero-engines and High-class Motor Cars.—Address, giving full particulars of experience and salary required, 1963, The Engineer Office. 1963 A

SITUATIONS OPEN (continued)

CHIEF DRAUGHTSMAN REQUIRED for Estimating Drawing-office of Structural Engineers. Must be able to take control of office and be fully qualified to Design and Estimate for all classes of Steel Structures on modern lines. Apply, stating age, experience, and salary required.—Address, "CHIEF," Wm. Porteous and Co., Advertising Agents, Glasgow. P7194 A

DRAUGHTSMEN REQUIRED, with Good General Civil Engineering Experience, capable of Designing Bridge and Structural Superstructures and Foundations by latest scientific methods without detailed supervision. Permanency assured to suitable men; no others need apply. Must state experience fully and salary expected.—Apply by letter to "DRAUGHTSMEN," Sir William Arrol and Company, Ltd., Dalmarnock Ironworks, Glasgow. 1935 A

DRAUGHTSMAN REQUIRED for North-East Coast, with experience of Lay-out of Electricity Works Plant. Superficial knowledge only of electrical side required, but must have good experience of mechanical and steam practice.—Address, stating full particulars and salary, 1896, The Engineer Office. 1896 A

EXPERIENCED DRAUGHTSMAN, Structural Engineers, London; used to Designing Steel-framed Buildings, Roof Work, &c., and capable of taking complete charge of jobs, including detailing. Sound theoretical knowledge essential. State age, salary, and previous experience.—Address, P7175, The Engineer Office. P7175 A

FIRST-CLASS DRAUGHTSMAN WANTED by Large Engineering Company in the Midlands, capable of Designing Gas Plant and General Structural Work. Good salary for the right man.—Address, stating age, salary expected, and experience, 1994, The Engineer Office. 1994 A

MACHINE TOOL DRAUGHTSMAN, for Firm in the Manchester district. Must be widely experienced and capable of designing special Machine Tools. Intimate experience of many classes of machine tools essential; detailers need not apply. Good prospects for suitable man.—Address, 1995, The Engineer Office. 1995 A

MECHANICAL DRAUGHTSMEN WANTED (with some Electrical Knowledge preferred). Men of first-class ability, workshop and technical training and sound experience; N.W. London. Good openings for first-class men.—Address, stating age, experience, and salary required, 1851, The Engineer Office. 1851 A

SENIOR DRAUGHTSMAN for Electrical Engineering Firm, with wide experience in the mechanical design of both A.C. and D.C. Machines. Applicants must not be under 25 years old and should write, giving full particulars of previous experience, age, and salary required.—Address, 1917, The Engineer Office. 1917 A

SWITCHGEAR DRAUGHTSMEN.—First-class MEN WANTED by Firm in N.W. London, with experience in Design and Lay-out of Up-to-date Switchgear. Only men with sound practical and technical training need apply. Good openings for really first-class men.—Address, stating age, experience, and salary required, 1968, The Engineer Office. 1968 A

WANTED, Energetic WORKING FOREMAN BLACKSMITH for General Structural Engineers in Midlands. Must be capable of improving methods and fixing prices. State age, experience, and references, also salary required.—Address, 1979, The Engineer Office. 1979 A

ENGINEERING.—WORKING FOREMAN WANTED for Small Constructional Plant in Lincolnshire; must have thorough knowledge of Planing, Boring, Turning, and Fitting. State age and wages.—Address, 1973, The Engineer Office. 1973 A

BLUEPRINTING MAN WANTED, to Take Charge of Manufacturing Engineers' Blueprint Room and Drawing Files. Knowledge of Hall's Rotary Machines and Modern Blueprinting, Photostatic, and Reproduction Processes essential, together with experience of routine filing and card indexing.—Address, stating age, experience, and salary required, P7132, The Engineer Office. P7132 A

SITUATIONS WANTED

ADVERTISER, Qualified Mechanical Engineer-draughtsman (24), WANTS POST as Assistant Works Manager or Engineer; 10 years' experience in steam, electrical, and I.C. plant; held similar appointments at home and abroad; lately engaged on asphalt manufacture; salary £450 to start; good refs., war service in R.E.s.—Address, P7183, The Engineer Office. P7183 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M., 613, c/o Deacon's, Leadenhall-street, E.C. 1941 B

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SITUATIONS WANTED (continued)

ENGINEER, MANAGER or FOREMAN. Mechanical and electrical, REQUIRES POST; sound shop experience in steam, electrical, and gas, works maintenance and erection; age 40, married.—Address, P7143, The Engineer Office. P7143 D

ENGINEER (25, Single), Rugby, B.Sc.A., B.A. (Cambridge), pupil locomotive works, SEEKS POSITION with good prospects as Assistant or under Contractor; A.M.I.C.E. exams., Miller prize, visited Switzerland and South Africa; country or Colonies preferred.—Address, P7179, The Engineer Office. P7179 D

MANAGER.—ENGINEER, with 16 Years' Management in crane trade, SEEKS CHANGE; would prefer London or South. Highest credentials and sound character.—Address, P7180, The Engineer Office. P7180 D

OIL FUEL BURNING EXPERT.—Qualified Marine and Mechanical ENGINEER, with extensive experience marine surveying and combustion of oil fuel, marine and industrial, well trained in engineering and allied sciences, building constructions, Spanish language, &c.; patentee of several oil-burning devices and author of standard book on oil fuel burning. Used to control of men and departments (age 39, retired). Position sought as Engineer Representative for London or Spain in connection with either marine work, oil fuel specialities, or general engineering.—Address, P7166, The Engineer Office. P7166 D

PARTNERSHIP or RESPONSIBLE POSITION, by initiative man; 8 years practical, 5 years D.O.; S.W.—Apply, "B.," 25, Argyle avenue, Hounslow. P7171 D

DRAUGHTSMAN (London District) SEEKS SITUATION; 18 years' good all-round engineering experience in shops and drawing-office.—Address, P7117, The Engineer Office. P7117 D

DRAUGHTSMAN (Mechanical), Wide Experience in design and lay-out of various industrial plants, power station design, general engineering, DESIRES SITUATION, London district.—Address, P7174, The Engineer Office. P7174 D

JUNIOR DRAUGHTSMAN (23) REQUIRES POST; 3 yrs. D.O., jigs and tools, die casting, general engineering.—Address, P7170, The Engineer Office. P7170 D

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GENTLEMAN, M.I.C.E., M.I. Mech. E., now holding important but uncertain position, is prepared to NEGOTIATE APPOINTMENT with SUBSTANTIAL and ENTERPRISING ENGINEERING CONCERN. Twenty years' successful management of engineering works and business in London district. Technical and commercial experience. GOOD ORGANISER AND NEGOTIATOR. Age under 50. PRINCIPALS OR SOLICITORS ONLY.—Address, 7152, The Engineer Office. P7152 C

AGENCIES

WANTED, LONDON AGENTS for Firm of Constructional Engineers in the Midlands.—Address, 1968, The Engineer Office. 1968 D

MECHANICAL and ELECTRICAL ENGINEER, with office in Birmingham and sound connection, would LIKE to REPRESENT a FIRM in the Midlands for gear where engineering knowledge is essential. Only well-known and reliable firms need reply. Own car.—Address, P7155, The Engineer Office. P7155 D

OLD-ESTABLISHED FIRM of Engineers and Ironfounders, Birmingham district, manufacturing specialities and general engineering work, REQUIRE established AGENTS to Represent them in London, Sheffield, Manchester, and South Wales on a commission basis.—Address, P7160, The Engineer Office. P7160 D

TOOL MERCHANTS and DISTRIBUTORS are INVITED to APPLY for BUYING AGENCIES for United Kingdom and British Colonies for novel, simple, and provisionally patented HAND TOOL for COILING TENSION and COMPRESSION SPRINGS.
Stocks now available for placing on market.
Address, P7177, The Engineer Office. P7177 D

MISCELLANEOUS

ANALYSIS and PHYSICAL TESTING of METALS, &c. Prompt and accurate reports. Certificated chemists only employed. Moderate fees.—BEECROFT and PARTNERS, Ltd., St. Peter's Close, Sheffield. 1829 I

DUNDEE DIRECTORY, 1923-24, in Preparation. ADVTS. and ENTRIES INVITED.
MATHEW,
Publishers, Dundee. P7141 I

ENGINEERS, Established London Thirty Years, DEVELOP Technically and Commercially Sound ENGINEERING IDEAS on mutual basis.—Communicate first instance to Box E. 466, c/o Dawson's, 121, Cannon-street, E.C. 4. 1679 I

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AUCTIONS

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BY DIRECTION OF THE DISPOSAL BOARD.

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WOOD-WORKING MACHINERY, ELECTRIC MOTORS and GENERATORS, SUCTION PRESSURE GAS PLANTS, RAILWAY COACHES, STEAM PUMPS, 6-TON GRAB, GRAVITY CONVEYOR, and MISCELLANEOUS ELECTRIC and OTHER STORES,

At NATIONAL CARTRIDGE AND BOX REPAIR FACTORY (No. 96, C.S.D.), ALEXANDRA DOCKS, NEWPORT, MON.,

On FRIDAY, APRIL 6th,

Commencing at 11 a.m. punctually,

Comprising :—

TWO SUCTION PRESSURE GAS PLANTS, each capable of an output of 20,000 c. ft. of gas per hour on anthracite fuel, by Power Gas Corporation; TWELVE RAILWAY COACHES, standard gauge, four wheels, four and five compartment, and TWO BRAKE VANS, by L. and N.W. Rly. Co.; ONE 20in. "CORONA" UPRIGHT DRILLING MACHINE; ONE 13in. "SELSON" HIGH-SPEED HEAVY-CUT SHAPING MACHINE; ONE "CHURCHILL" No. 3 INTERNAL GRINDING MACHINE; ONE 9½in. centre LATHE, S.S. and S.C.; ONE FIVE-SPINDLE VERTICAL BORING MACHINE, by Ransome and Co. Ltd.; ONE THREE-SPINDLE DITTO and FIVE TWO-SPINDLE DITTO; TWO VERTICAL BORING MACHINES, by J. Sagar and Co.; TWO TONGUEING and GROOVING MACHINES (D.P.), by J. Sagar and Co.; ONE NEARLY NEW 2in. by 1in. FOUR-CUTTER LATHING MACHINES, by J. Sagar and Co.; TWO MASSIVE CROSS COMPOUND QUADRUPLE-ACTING STEAM PUMPS, each capable of delivering 24,000 gallons per hour against a head of 66ft. with steam pressure of 80 lb. per sq. in., by Frank Pearn and Co., Ltd.; ONE 6-Ton "PRIESTMAN" GRAB; ONE 50 B.W. STEAM GENERATING SET, 107 volts D.C., Engine by Bellhss and Morcom, Dynamo by Westminster Engineering Co. Ltd.; NINETEEN A.C. ELECTRIC MOTORS and STARTERS, 440 volts, 3-phase, 50 cycles, comprising Five 1 H.P., Six 5 H.P., and One 10 H.P., One 12½ H.P., Two 15 H.P., One 17½ H.P., and One 20 H.P., by British Westinghouse Co. and B.T.H. Co. FOUR D.C. ELECTRIC MOTORS, comprising Two 8½ H.P., 220 volts, by Vickers; One 10 H.P., 220 volts, by Veritys, Ltd.; and One 12 H.P. 220 volts, by Mather and Platt; QUANTITY of ELECTRICAL STORES, including Electric Cable (various), Gunmetal and White Metal Bearings, Stator Coils, Brushes, Fuse Boxes, Conduit Boxes, Cleats, Blocks, Insulators, Switches, Electric Lamps, Water-tight Fittings, Shades, Ohmer Testing Set, Electric Radiators, &c.; TWO ELECTRIC MOTOR SIGNALS, 110 volts, sound 1760 yards range; ONE ELECTRIC KLAXON SIGNAL, 110 volts; Two 12in. Copper Alarm Bells; One "Eowa" Patent Steam Kettle, 10 gallons capacity; About 700ft. GRAVITY ROLLER CONVEYOR in 8ft. lengths, rollers 2½in. by 14in.; About 200 YARDS JUBILEE TRACK, with several Sets of POINTS and CROSSINGS; FIVE STEEL SIDE-TIP JUBILEE WAGONS, ½ cu. yd. capacity; FOUR "GOODALL" TIMBER TRUCKS and THREE "BARRETT" MULT TRANSPORTER TRUCKS, Model M. 630, capacity 2000 lb.; Three Line Top Tables, 5ft. by 3ft., and Large Quantity of Miscellaneous Stores, &c.

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G. R.

BY DIRECTION OF THE DISPOSAL BOARD.

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At Eleven o'clock each day, including :—

TWO LOCOMOTIVES, Side and Saddle Tank, standard gauge, by Manning, Wardle & Co.; TWO LANCASHIRE BOILERS, new, 30ft. by 7ft., tested to 160 lb., by Tinker, Shenton and Co., Ltd.; TWO SETS of TWIN Forced Draught FURNACES; Quantity of WIRELESS MATERIAL; STEAM CRANE, 1 Ton, by Taylor and Hubbard, Leicester; 7-Ton STEAM CRANE, by H. J. Coles, Ltd.; 15 H.P. GAS ENGINE (Crossley); HAND ELEVATORS; PAPER BALING PRESS; Plain Grinder; TWO MARINE ENGINES; HOP CRIMPING MACHINE; VERTICAL THREE-THROW HYDRAULIC PUMP; TWO 530 H.P. SUBMARINE DIESEL ENGINES; Motors and Starters; TWO 10in. HEXAGON TURRET LATHES, new, by H. W. Ward and Co., Birmingham, with 10 H.P. Motor and Starter, by Siemens; Three Enclosed Tender D.C. Motors; 10in. Turbine Pump, by Mather and Platt; 14in. Worthington Centrifugal Pump; 20-Cwt. 4th Crane; PORTABLE CONCRETE MIXING MACHINE; Blake Sole Stitching Machine; TWO REES ROTURBO PATTERN PRESSURE CHAMBER VENTILATING PLANT with 12½ H.P. Motor and Parts; HYDRAULIC SHELL WASHING MACHINE, complete with hydraulic three-throw pumps; Band Saw Machine; Surface Planing Machine; Varnish Economiser Hand Pumps; TURBINE PUMP; Bar Reeling Machine; Rack Drive Planing Machine; MARCONI WIRELESS SET; 3, 5, 8, 10, 12, 15, 20, 25, 40, and 160 and 400 H.P. ELECTRIC MOTORS and STARTERS; Transformer fitted with breaker switch and isolating links; HAMMER-HEAD ELECTRIC CRANES, 6 cwt.; 25-Ton ELECTRIC PRESSES, by Hindle, Son and Co.; 5774, Yards Electric Cable; Terminals, Ebonite Bushes, Black Enamel Bends, Cleats, Clips, Elbows, Distributing Boxes, Insulators, Lamps, Glasses and Shades, Switches, Tinned Copper Wire; ELECTRIC FAN and MOTOR; AUTOMATIC STARTERS, Ammeters, Crane Slings, Railway Platforms, Trolleys, Shell Trolleys, Sack Trucks, Fire Extinguishers and Buckets, Iron Handle Grips, Brass Rams, Condenser Cylinder, by Castner; Centrifugal Gas Blower with Motor, Two 2½in., Seven 10in. Rotor Pumps with parts, Circular Saw Bench, Transformers, Oil-cooled Single-phase Starting and Running Panels, Switchboards, Gantry consisting of Steel Girders and Stays, Steel Castings, Wheels and Tubes, Large Quantity of Leather Belting, 16 Paraffin Stoves, Large Quantity DRUMS of SILICON, Hand Winches with Three Derrick Poles, Set of Weston Chain Blocks, Beam Scales, Platform Scale, by Pooley; Collapsible Tables, Filing Cabinets, Cupboards fitted with shelves and doors, Oil Drums, Wheelbarrows, Trestles, 3000 lb. of Paint, various colours, &c.

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For continuation of Small Advertisements see page 3

The Early History of the Gas Process.*

By DAVID BROWNLIE.

THE evolution of gas from decaying vegetable matter had doubtless been known for many centuries, and in 1600 Van Helmont, a famous Dutch chemist resident at Brussels, had observed that coal "did belch forth a wild spirit or breath." The word "gas" in fact, seems to have been originated by Van Helmont, being apparently derived fron the word "geist," German or Dutch for "ghost," or perhaps from "gast," meaning yeast. The earliest account of an illuminating gas given off by coal is that of Thomas Shirley in the "Philosophical Transactions" for 1667. He noticed gas issuing from a spring near Wigan, and on collecting samples, found that it would light, although he had no ideas with regard to its origin. The first man who seems to have observed the evolution of an illuminating gas by definitely carbonising various forms of vegetable matter, including coal, would appear to have been Robert Boyle in 1691, and in 1726 Dr. Stephen Hales mentions early experiments on carbonising coal in his publication "Vegetable Staticks."

We now come to the Rev. J. Clayton, the Dean of Kildare, who also experimented with the inflammable gas at Wigan, but who rightly surmised that it came from the coal seams below. He then heated coal in a vessel over an open fire, and in his own words:—"at first there came over only a little phlegm, afterwards a little black oil and then likewise a spirit arose which I could in no ways condense." Clayton wrote to the Hon. M. Boyle describing his experiments, in which he speaks of gas as "the spirit of coals," and this letter was published in the "Philosophical Transactions" of 1739 (Vol. 41, pp. 59–61).

Coal was apparently first carbonised on a commercial scale, for the production of coke, at the iron works of the Prince of Nassau-Saarbrucken at Sultzbach, and a detailed description of the process is given by the French author, de Gensanne, who had made a personal inspection of the plant, in a book published in Paris, in 1770. In addition to the production of coke, the coal tar was also recovered, but no one seems to have thought of using the gas, which must often have taken fire and blazed on a very large scale. The results of experiments on the distillation of coal were also published by Watson in 1781, and in the same year this question occupied the attention of the Earl of Dundonald. Another very early worker about this period was Minckelers, who, in 1784, investigated the possibility of using gas for ballons.

The real originator, however, of the gas process, and the first man who systematically carbonised coal and other vegetable matter with the definite object of obtaining an illuminating gas was William Murdoch. Murdoch was born in 1754 in the village of Lugar in Ayrshire, the son of a small farmer, and his remote ancestors are said to have been of Flemish extraction. He was of an inventive turn of mind from a boy, and seems to have experimented at a very early age in heating shale in an iron pot, there being a small outcrop of shale in his father's cabbage garden. A cave is still shown to this day where these early experiments are said to have been carried out. Murdoch left his native village in 1777, when he was 23 years of age, and obtained a situation as a mechanic with Messrs. Boulton and Watt in Birmingham. It is not known when he actually commenced his experiments on the gas process, but by 1792 his work in this connection was in full swing, in spite of his busy life among the Cornish mines, and he lighted his house at Redruth with gas during this year. He used for his experiments a cylindrical iron pot set in brickwork over an open fire in the yard of his house. This pot held about 15 lb. of coal, and was closed at the top by a lid and provided at the side with a delivery pipe, the crude gas being burnt merely at the end of an open pipe, until the accidental use of an old thimble with a hole in it, discarded by his wife, resulted in the substitution of a burner formed like a thimble perforated with a number of small holes In this way Murdoch systematically carbonised a real number of vegetable products, not only many varieties of coal, but also wood and peat, estimating the yield in each case.

Unfortunately his employers, Messrs. Boulton, and Watt, were not enthusiastic, and tried to dissuade him from continuing the work, and Murdoch seems at one time to have thought of leaving their employment on this account. Boulton relates that on one occasion when visiting Cornwall, he accidentally met Murdoch about to enter a London coach, and persuaded him to abandon the journey. Murdoch stated he was going to look for mechanics, but Boulton felt certain he was really going to London to try and find people to help him financially with his gas project.

Murdoch, however, could not be turned away from his gas process, and he is said, in 1797, to have lighted a house at Old Cummock in Ayrshire, where he was staying. The following year he left Cornwall for good to take up a permanent position at the Soho works in Birmingham, and, in his own words:—

"In the year 1798 I removed from Cornwall to Messrs. Boulton, Watt and Co.'s works for the manufacturing of steam engines at the Soho Foundry, where I constructed an apparatus upon a larger scale, which during many successive nights was applied to the lighting of their principal building, and various new methods were practised of washing and purifying the gas. These experiments were continued with some interruption until the peace of 1802, when a public display of this light was made by me in the illumination or Mr. Boulton's manufactory at Soho on this occasion. Since that period I have, under the sanction of Messrs. Boulton, Watt and Co., extended the apparatus at Soho Foundry, so as to give light to all the principal shops, where it is in regular use, to the exclusion of all other artificial light."

As soon as he got settled down at Soho Foundry, Murdoch began to experiment systematically with many different kinds of cast iron retort to get over the difficulty of extracting the fused mass of coke. He seems to have very soon arrived at the horizontal retort with a section of the shape ⌂ almost identical—except as regards size—with the fireclay horizontal retorts in use to-day. Some of these retorts were also of the "through" variety, that is, they could be opened at each end, and the sizes he used varied from 3ft. to 7ft. in length and 12in. to 20in. wide.

Fig. 1 represents one of the identical installations erected by Murdoch at Soho Foundry, somewhere about 1798, and is an astonishing piece of work, with the retorts in settings of three, direct fired underneath, with the stand-pipes from each retort going to the hydraulic main across the top of the setting and special arrangements for cleaning the tar out of the pipes. Fig. 2 shows the original gasometer as used by Murdoch with this installation, which was actually in use until 1910, latterly for producer gas. Here again Murdoch's design is astonishing and essentially the same as the modern gasometer, and it is a striking tribute to the genius of Murdoch that he should have been using a gasometer in 1798 when some of the gas companies in London—as we shall see later—were still struggling with the use of canvas balloons to store the gas.

Murdoch also used for bulk gas production a cast iron pot form of retort, fitted inside with an iron cage holding about 15 cwt. of coal. When the carbonisation was completed, the cage containing the residual coke was lifted out with a small crane and replaced with another cage of coal. In 1805 Murdoch utilised this form of retort in equipping the first factory, apart from that of Boulton and Watt's establishment in 1802, with gas lighting, that of Messrs. Phillips and Lee's cotton mill in Manchester, which was fitted with a complete gas plant and 900 gas burners, in addition also to lighting Mr. Lee's private house. It is possible this pot form of retort was intended for smaller installations, and that the horizontal retort type—see Fig. 1—was for large public companies, as it hardly seems likely that Murdoch should have abandoned this type of installation, as already stated, essentially as used to-day.

The burner used by Murdoch at this time was a closed tube with holes at the end, based on his original thimble burner, but subsequently in 1808 he invented the "cockspur" burner, giving three tiny divergent jets merging into one flame giving about one candle-power per cubic foot. Murdoch gave a paper on this installation before the Royal Society of Arts in 1808, and was awarded the Society's Rumford Gold Medal. The paper contains a simple and lucid account of the results obtained. The cost of the production of the gas was £650 per annum, using a mixture of 110 tons of cannel coal at 21s. per ton and 40 tons of ordinary coal at 10s. per ton, and the 900 gas burners gave a better light than candles at 1s. per lb., costing the mill £2000 per annum. However, Boulton and Watt were still not particularly enthusiastic, being finally only stirred to action by the advent into London of an individual named Winsor.

Meanwhile, about 1791, a French investigator

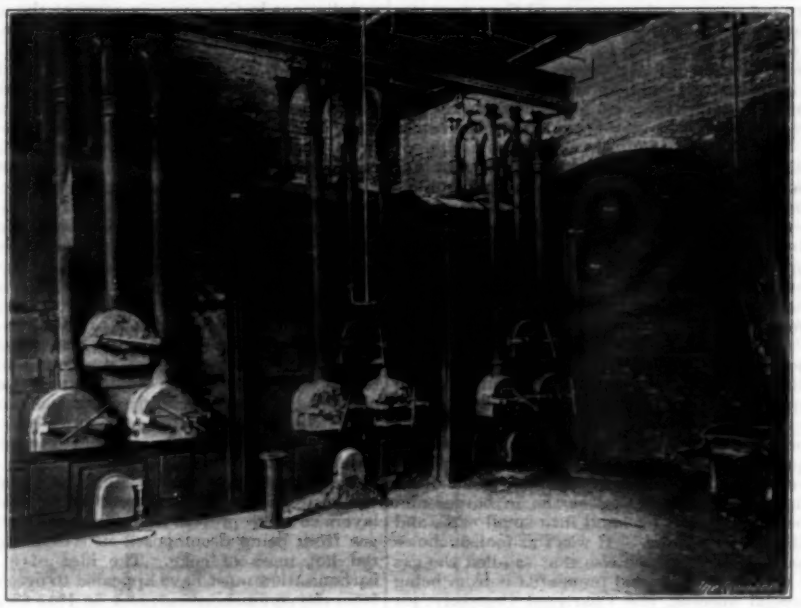


FIG. 1—GAS PLANT ERECTED AT SOHO BY MURDOCH, CIRCA 1798

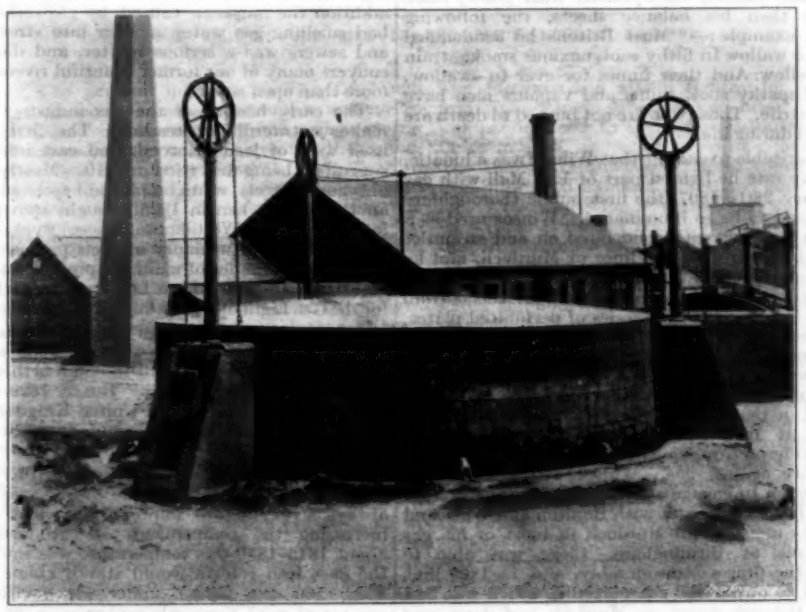


FIG. 2—GASOMETER FOR MURDOCH'S SOHO GAS PLANT

* Newcomen Society, March, 1923.

named Lebon, an engineer in the service of the French Government Department of Bridges and Roads, had commenced experiments with the carbonisation of sawdust, and produced a brilliant illuminating gas. This work was carried out quite independently of that of Murdoch, and in France Lebon is rightly regarded as one of the originators of the gas process. Lebon seems to have worked on very similar lines to Murdoch, completing most of his work by 1799, and eventually he created a public sensation in France in 1801 by lighting his house in the Rue St. Dominique, Paris, with gas. The fame of these demonstrations spread through the Continent and attracted the attention, among others, of a German named Winsor, Winzer, or Wintzler, who was born in Moravia. This Winsor, as he is generally called in English literature, travelled specially from Frankfort to see the demonstration, and apparently tried—without success—to come to some business arrangement with Lebon. Winsor then seems to have experimented himself until he discovered the method of making gas from coal, and subsequently came over to London with the object of developing a heat and light company for the manufacture of gas, because, as he wrote in one of his pamphlets: "the thought of introducing the discovery for the advantage of the British realm struck me like an electric shock."

He took up his quarters in 1806 at the Star and Garter Hotel, 97, Pall Mall, a site now occupied by the Carlton Club, and his efforts to establish the gas industry by means of lectures, demonstrations, and pamphlets caused an undoubted sensation. If the statements made by Lady Bessborough, writing on September 7th, 1807, to the Earl of Granville, are true, one can well believe it. According to this lady, Winsor promised a return of 6000 guineas a year for every 7 guineas subscribed, and 17,000 shares were sold in ten days, the price rising from par at 1 guinea to 7 guineas per share, with every prospect of rising to 100 guineas per share, whilst Pall Mall was blocked with people in carriages, on horseback, and on foot, rushing to invest. The good lady, who apparently had the misfortune to hold a lot of shares, began to be dubious, and wrote concerning the scheme that "it would probably involve half England in ruin, me among the rest, and prove a second South Sea bubble."

Winsor gave in his own pamphlets a most elaborate and incomprehensible balance sheet, showing apparently that an annual return of £64 10s. 0d. was to be expected from every £6 expended, and talked about "1000 per cent. being saved and gained in heat, light, and some valuable products for British manufacturers, commerce and navigation."

One of his advertisements in 1807 stated: "Official experiments prove one chaldron of coals to contain £23 2s. 0d. in value, which gives about £242,000,000 for the yearly consumption of the realm. The estimated savings are only rated at £114,845,294, all costs of carbonising, &c., deducted, and if the company only realise one-tenth of this reduced sum, each £5 deposit will secure to the subscribers £570 per annum."

Winsor's frenzied appeals were in striking contrast to the simple and lucid statement of Murdoch in 1808, and he also backed his opinions with poetry more appalling than his balance sheets, the following being an example:—"Must Britons be condemned for ever to wallow In filthy soot, noxious smoke, train oil and tallow: And their fumes for ever to swallow. For with sparky soot, sniffs, and vapours men have constant strife, Those who are not burned to death are smothered during life."

It is charitable to assume that Winsor was a lunatic, but at any rate he lighted part of Pall Mall with gas on January 28th, 1807, the first public thoroughfare in the world to be so illuminated. Winsor used as a retort an iron pot with a lid luted on and an outlet pipe in the centre, on the lines of Murdoch, and he passed the crude gas through a condenser consisting of a circular conical cistern, broader at the bottom than the top, divided by a series of perforated plates, the object being to purify the gas by spreading it out and separating a little of the tar. The whole of the ammonia, sulphuretted hydrogen, carbon bisulphide, and other poisonous impurities of course remained in the gas, so it is not surprising that the audience at Winsor's popular lectures on the gas process suffered from violent headache, which created a prejudice against gas. Winsor was subsequently lucky enough to engage a man named Samuel Clegg, who had been a mechanic with Boulton and Watt, and worked as assistant to Murdoch in most of his gas experiments at Birmingham. Clegg was able to improve the process considerably, and in 1806 lime was used to purify the gas partially, which was first bubbled through water, as Murdoch had done, and then passed through lime and water. It would appear that this use of lime was first suggested by William Henry, of Manchester, the well-known chemist. At this very early period the gas pipes used were of lead and the burners of copper. Winsor finally got his Heat and Light Company started, the capital of £50,000 being over-subscribed, and he then applied for a charter to the House of Commons. There was violent opposition to this application, particularly by Boulton and Watt on behalf of Murdoch as the original inventor, although, as already seen, they themselves had done very little to help the process. The Bill was subsequently thrown out, but another Bill was introduced at the next session, and passed finally into law on June 9th, 1810.

In 1812 the London and Westminster Chartered Gas Light and Coke Company, received a Royal Charter of Incorporation and became subsequently the present Gas Light and Coke Company. The first Chief Engineer of the Chartered Company was Samuel Clegg, who was a man of very great ability and can justly be regarded among the pioneers of the gas industry and second only to Murdoch. Clegg, presumably under Murdoch's direction, had lighted a cotton mill in Halifax with gas in 1805, and also erected other gas plants at Manchester, Coventry, and Hyde, and after his appointment as Chief Engineer, which undoubtedly saved the company, he invented in 1809 an improved wet lime purifier, the first gas meter in 1815, the wet gas meter with a revolving drum in 1816, and also—as will be discussed later—several types of continuous retort. Clegg's gas meters, however, were not a practical success until they were improved by John Malam, who also invented the first dry gas meter in 1820. This John Malam may also be regarded as one of the pioneer gas engineers, starting as a draughtsman at the Peter-street Gas Works in 1817, and in addition to his work on the gas meter, he also improved very considerably the retort settings, and devised an improved combination of three wet lime purifiers. The Chartered Gas Light and Coke Company, in addition to many practical troubles, very soon had to face severe competition, and in 1814 the South London Gas Company (afterwards the Phœnix) started, followed in the same year by the City Gas Company, who opened a gasworks in Fetter-lane. There was, however, such an uproar about this because of the smell and the general nuisance that in 1815 they were compelled to remove to Blackfriars. The gas industry made the terrible mistake at this early stage of building their gasworks in thickly populated neighbourhoods, and the Chartered Gas Light Company had, for example, its first works in Peter-street, Westminster, and Brick-lane, St. Luke's. This meant that extravagant prices had to be paid for land when extensions were required, and ruinous charges were incurred for the conveyance of the coal, which was brought down the Thames, mainly from Newcastle, in barges and had to be all unloaded by hand into small carts and conveyed to the gasworks. It was this foolish choice of sites more than anything else that saddled the gas industry with difficulties and prevented it from being a commercial success, the Chartered Company, for example, paying no dividend until 1817. Also the gas companies were, quite rightly, in continual serious trouble because of the intolerable nuisance caused by these early gasworks, and the gas industry of that time certainly had very little regard indeed for the community in the matter. In addition to the general foul smells given off—and even a modern gasworks is not very pleasant in this respect—the gas was purified in wet lime purifiers, and the stinking lime cream residue from the purifiers, known popularly as "blue billy," was carted continually through the streets, creating a serious nuisance. In 1817 Reuben Philips, of Exeter, invented the dry lime purifier, but the gas industry refused to adopt this clean, simple and efficient system until they were forced, by threatened legal action, to do so eleven years afterwards. In addition the nuisance caused by gasworks throwing bad smelling gas water and tar into streams, rivers and sewers was a serious matter, and did much to convert many of our former beautiful rivers into little more than open sewers.

The early history of the gas industry altogether makes extraordinary reading. The first gas pipes used were of lead or wood, and cast iron was also suggested, being first tried in 1810. Mostly, however, old gun barrels were employed, screwed into one another, and when in 1825 wrought iron pipes were introduced by Whitehouse, these were known as "gunbarrels" in memory of their predecessors. By 1816 about 15 miles of main gas pipes of various sorts and sizes had been laid in London, Clegg's first mains for the Gas Light and Coke Company being only 2in. dia.

About 1820 the price of gas was something like the equivalent of 15s. to 20s. per 1000 cubic feet, and even this was one-third to one-fourth the cost of oil lamps for an equal light. But by 1829 there were over 200 gasworks in the United Kingdom, and the price of gas in London had been reduced to about 12s. per 1000 cubic feet.

The gas industry, however, continued to experience great difficulty in making the process pay, and was always struggling to improve the yield of gas by increasing the temperature of carbonisation. By about 1845–1850 this temperature was the maximum the cast iron retorts would stand, about 1400 deg. Fah. (760 deg. Cent.), under which circumstances one ton of good Newcastle coal gave about 8000 cubic feet of gas, a big improvement, although the gas was somewhat reduced in quality, and the coke more difficult to ignite because of the reduced amount of volatile matter. The melting point of cast iron is about 2000 deg. Fah., and the wear and tear on the retorts, even when protected by fireclay shields, was ruinous. The average life, with great care, did not now exceed about eight to nine months under the best conditions, and at a carbonisation temperature of over 1475 deg. Fah. a very few months was sufficient. The price of these retorts was also very high, about £6 to £7 per ton, and the retorts meant a cost of 6d. to 7d. per 1000 cubic feet on the gas.

For high temperature carbonisation the cast iron retort was doomed, and the obvious material was fireclay, as used to-day, which was the original adoption of John Grafton in 1820. Grafton erected his first retorts at Cambridge Gas Works in 1824, consisting of square ovens built of firebrick, holding 4–5 cwt. of coal at a charge, an enormous increase as compared with the small cast iron retorts. These new retorts had a number of advantages. In the first place the temperature of carbonisation was raised without difficulty to 1750 deg. Fah., which caused a complete revolution in the gas process. The yield from one ton of Newcastle coal was increased to about 8750 cubic feet of gas and very soon temperatures of 2000 deg. Fah. were attained, with a yield of 9500 cubic feet, whilst the composition of the gas was altered considerably, with formation of benzene hydro-carbons due to "cracking" of the paraffins. The life of the retorts was very satisfactory, the first installations lasting over six years at the much higher temperature, whilst the quality of the coke was excellent.

As already stated, the introduction of the fireclay retort was a revolution in the gas industry, and inaugurates what may be termed the intermediate stage of gas manufacture, whilst at the same time the price was being gradually brought down, being, for example, in 1849 an average of 6s. per 1000 cubic feet in London. More experience with fireclay retorts and still higher temperatures enabled the gas yield to be increased to 10,500 cubic feet per ton on Newcastle coal, and by about 1860 a more or less standard gas of sixteen candle-power was adopted for London.

There are still a number of other points of interest in connection with the early history of the gas process. In 1856 the famous chemist, W. H. Perkins, discovered the first aniline dye mauveine, when trying to synthesise quinine from the organic compound aniline. This led to a new source of revenue for the gas industry, and a use for the particularly obnoxious waste product, coal tar, since aniline is made from benzene, one of the constituents of tar, so that the tar distillery industry dates from this time.

It was soon realised by Murdoch himself that for the best quality gas coal must be carbonised in thin layers so as to prevent the richer constituents of the gas from being decomposed in struggling through a red hot mass of coke. The idea of a continuous carbonisation must have appealed to inventors almost from the commencement, and in 1815 Clegg patented various continuous retorts in which the coal was carbonised in thin layers. One of these retorts was of rotary design, provided with shallow boxes attached to radial arms rotating round a central shaft. The coal was charged into the trays at the cool side of the retort and the tray of coke subsequently removed, carbonisation taking place on the heated side of the retort. Clegg also invented a web retort, in which coal was carried on an endless chain and carbonised in a thin layer as it travelled through the carbonisation chamber; but all these earlier continuous retorts were abandoned, chiefly because of the excessive wear and tear.

The vertical gas retort was the original invention in 1828 of John Brunton, the brother of William Brunton, and embodied in his patent 5712/1828. John Brunton has received very little credit indeed for his remarkable invention, which, apart from the retort being of cast iron, anticipated in an astonishing fashion not only the modern vertical intermittent retort, but a number of other refinements in the working of gas retorts.

William Brunton was engaged by Boulton and Watt in 1796 as a mechanic, and in 1802 was appointed superintendent of the Soho engine yard, a separate establishment of the Soho Foundry. It was whilst in this position that he apparently engaged his brother John as a mechanic. At any rate, John was also an employee of Boulton and Watt for a number of years, and along with Samuel Clegg assisted Murdoch with his gas experiments at the Soho Foundry. William Brunton left the firm in 1807 when he went to the Butterley Iron Works, and in the South Kensington Museum there is an original letter from him dated April 28th, 1813, addressed to his brother John who who was then in Belfast, his address being "c/o Mr. J. Rider, Belfast Foundry, Belfast." This letter was written whilst William was still at Butterley, but unfortunately gives no clue as to what John was doing in Ireland. When the patent for the vertical retort was taken out, John Brunton was Chief Gas Engineer at West Bromwich,

Apparently John Brunton erected his vertical retorts at West Bromwich, and ran them for a number of years, but nothing further is known about them except that the early text-books on gas manufacture simply state the idea was found to be impracticable, without giving any reason, the same idea being tried in 1829 by Barnet.

Brunton seems to have invented also a mechanical charging mechanism for horizontal retorts, which certainly worked at West Bromwich for a number of years, until he retired, when it was abandoned. This appliance consisted of a hopper holding 20–28 lb. of coal and a piston working through as tuffing-box and propelled by a double-threaded screw which charged the retort once every hour, the time of charging being six seconds. The red hot coke at the other end of the retort was discharged into water, and Brunton stated that 35 per cent. more gas was obtained by this

process. One of the difficulties, however, seems to have been that the tar was absorbed by the coke and thereby rendered unsaleable.

In 1855 Rowan carbonised coal in a cupola, the coke being taken out intermittently at the bottom through a water seal, but the gas industry would not consider anything but the horizontal retort and the vertical retort consequently lapsed entirely.

It was not until 1902, that is seventy-four years later, that the vertical retort came to life again with the work of Settle and Padfield at Exeter, patent 12,252/1902, and later on in the same year the patent of Dr. Julius Bueb, of Dessau, in Germany, 15,154/1902. These were intermittent retorts, and in 1903 Woodhall and Duckham took out the first patent for a continuous vertical retort. The history of the vertical retort in general is of course outside the scope of this paper, but it is only fair that the pioneer genius of John Brunton should now be recognised. It is a remarkable fact also that William Brunton has never received the true recognition of his great genius, and as an example of this the short life of William Brunton in the "Proceedings of the Institution of Civil Engineers," from which the account in the "Dictionary of National Biography" is copied, never even mentions his epoch-making work of the original invention of the practical mechanical stoker.

With regard to the use of gas, it will have been realised that the whole process of gas manufacture originated entirely to supply gas an as illuminating agent in competition with candles and oil, and until quite recent years this was the chief function of gas. But by about 1851 a few gas-cookers were used in hotels and restaurants, following on the great exhibition at Hyde Park in that year, when a number of gas stoves were exhibited. The development of gas cooking was, however, very slow in the early period of the gas industry.

Gas was first used for gas fires for the heating of rooms about 1840, and what may be termed the modern gas fire was patented by Edwards in 1849, whilst the first gas water-heater was that of Robert Hicks, in 1825, but no real development was made in this direction in the use of gas until about 1890.

Chinese Government Railways.

(From our own Correspondent in China.)

THE PEKING-MUKDEN RAILWAY.

At the Washington Conference Chinese affairs claimed much attention, and not the least of the problems dealt with hinged on railways which in China have an important political and financial as well as engineering and operating aspect. Probably the conditions under which future railways will be built will differ from those of the past. The Peking–Mukden Railway illustrates well the evolution of railways in China.

THE EARLY DAYS.

Unaccustomed to dealing with the outside world and dreading any advance into unknown paths the Chinese Government destroyed the narrow gauge Woosung Railway. But the very problem thus presented, viz., how to fend off the "opening" of China brought the matter of defence urgently before the Government: navies and coal, armies and transport spurred on the advocates of railways to try again. The Chinese Engineering and Mining Company, then a private company, was promoted in 1877. With the utmost difficulty sanction was obtained to lay seven miles of rails from Tongshan to Hsukochuang, at the canal, the vehicles to be horse drawn.

The first spike on a standard gauge railway in China was driven in June, 1881, in which year the "Rocket of China," secretly constructed by Mr. Kinder, was put to work on what was known as the Kaiping Railway. In 1884 the railway and mines were separated, and in 1886 the Throne consented to the extension of the line to Lutai and Yenchuang. The China Railway Company then pushed on towards Tientsin, the first train entering that place in 1888. An eastern extension to Kaiping was opened in 1889. The first Imperial recognition of the locomotive was in 1884. The utmost economy had to be observed on this early line, but Mr. Kinder was determined that the people of China should see what a railway was like, and although only £3000 per mile was available the engineer triumphed over all obstacles. But the effort was the utmost that could be made privately, and no more funds could be obtained to extend the line.

BEGINNING OF GOVERNMENT CONTROL.

The usefulness of railways having been demonstrated, Li Hung Chang, then Viceroy of Chihli, took up the work of extension; the Government contributed 2 million taels, and thus Government interest was initiated. The line reached Kuyeh in 1892, Shanhaikuan in 1894, Sui Chuang Hsien in 1897. The Lanchou bridge, 2200ft. long, with five central spans of 200ft., the first large bridge ever built in China, was opened with great ceremony in 1894. At the same time the Tientsin end was extended, but the railway was not permitted to approach closely to Peking, nor go directly, but terminated officially at Lu ku Chiao, and really at Ma Chia Pu over a mile outside the south gate of Peking. The single line was opened in 1897, the double line in 1898, and the tramway to the south gate—an insidious approach to sacred ground—in 1899. Before the Peking line was undertaken, the China Railway Company had been absorbed into the Government undertaking about 1894, and by 1898 regular traffic was being conducted from Peking (Ma Chia Pu) to Sui Chuang Hsien, a distance of almost 300 miles. By then the railway was consolidated into one concern, the Imperial Railways of North China under a Director of Railways and the Viceroy of Chihli. Thus far the railway had been a purely Chinese Government concern, with a British engineer-in-chief and staff. But just as the Kaiping Company had been unable to finance the company in its earlier stages, so now even the Government—crippled by the war with Japan—came to the end of railway building out of revenue, and the raising of capital became the new problem.

* Newchwang is near Ying-kow.

THE RAILWAY LOAN.

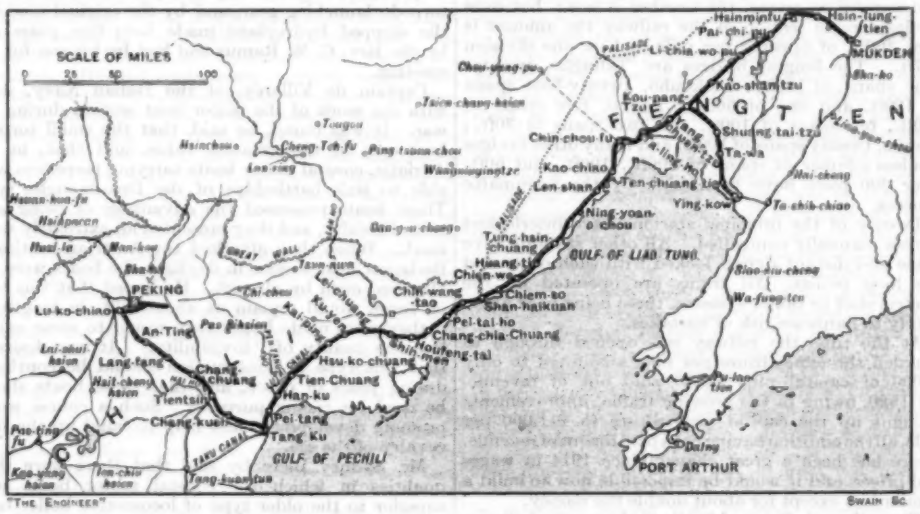
The great diplomatic attack by Russia on China's railways, for the purpose of ousting the British staff and securing Russian control, would require a volume to relate. In the end a British loan was arranged to extend the railway to Hsin Min and Newchwang,* and rather than exhume the disputes of the past, it is pleasanter to observe how satisfactorily the loan has worked out. At that time not much was known about the ability of Chinese railways to refund loans. There were great risks, but with great faith a 5 per cent. loan of £2,300,000 was finally floated in 1898 to extend and improve the railway and pay off other miscellaneous loans. Up to now the interest has never been in doubt, and nearly one half of the capital has been redeemed out of revenue. In the ordinary course of events, in the forty-fifth year of the loan the railway should be in the unique position of having paid off from revenue the entire capital account. The present military position in North China has, however, caused considerable anxiety to those interested in this railway, and unless strong action is taken without delay to recover the rolling stock at present held up by General Chang Tso Lin in Manchuria, there will not be sufficient revenue to pay interest on the loan. The decrease in revenue this year, owing to the military people holding up rolling stock, has amounted to nearly $10,000,000, and at the moment the Manchurian War Lord controls no less than 75 per cent. of this railway's rolling stock, which he is using exclusively in Manchuria. If this action should result in the railway defaulting in the payment of interest or redemption, it will be the greatest blow to China's foreign credit that she has ever had. The Central Government is powerless as far as General Chang is concerned, and all the diplomatic protests that have been made by the British Legation have had no effect. The real trouble is that there is no Government in China to-day, and the Tuchuns (Military Governors) are ruining the country with the various little wars that are going on amongst themselves. The Peking-Mukden Railway has served as the training ground of a majority of the Chinese engineers now constructing other lines. Products of all countries are to be found on the line, no restrictions on purchasing having been arranged. The Directors retained their former status as in the days before the loan, and except for the grumblings of a few young politicians, ignorant of the past, the result is undoubtedly very satisfactory and very creditable to the engineers and management. With the loan funds the work, abandoned after the war of 1894, was resumed, and in October, 1899, traffic was opened to Chinhsien. Rail laying eastward from Chinhsien and westwards from Newchwang was then begun, and in February, 1899, the two rail heads met near Shuang-tai-tze, thus connecting for the first time two of the Treaty Ports, previously almost cut off from each other. A start was made with the track from Koupangtzu to Hsinmin, but rails had only reached Tahushan—25 miles—when once more the railway was entangled in a political upheaval, which not only stopped all new work, but led to the destruction of the important part of the line from Peking to near Tongshan in 1900, and the subsequent occupation by various military forces.

For a time the outlook was black, but in the end, rivalling the Phœnix, the railway emerged from the ashes, greater than ever. The destroyed portion was restored, but the double track from Tientsin to Peking could only be re-made as single track, which it still remains. The opportunity, however, was given to extend from the Ma-Chia-Pu terminus into the city at Peking—first into a station at the Temple of Heaven and soon after to the present terminus at the Cheng-Yang-Men and out to Tungchow. These improvements were effected during the *régime* of the British Military Administration, which controlled the line from Peking to Shanhaikuan up to February, 1902. The Russian Military Administration held on to the Shanhaikuan-Newchwang section until October, 1902, so not till then did the Imperial Railways Administration resume control, after a break of nearly two and a-half years.

GENERAL PROGRESS.

Although the rails met in February, 1900, much remained to be done to complete the line to Newchwang, which for a time was the main eastern terminus. The Hsin-Min line was also resumed where it left off in 1900, and rails arrived at Hsin-Min in 1903.

Scarcely had this been completed when the eastern end of the railway was once more involved in the disturbances caused by the war between Japan and Russia. Fortunately, however, the railway remained just outside the actual zone of fighting. The events of 1904 and 1905 led to the extension into Mukden, which had previously been barred by the Russians.



MAP SHOWING THE LINE OF THE PEKING-MUKDEN RAILWAY

The Japanese laid a field railway for war purposes from Hsin-Min to Mukden, and after negotiation it was handed over to the Imperial Railways of North China in 1907, under the terms of a loan agreement. The Imperial Railways of North China altered the field railway to standard gauge, and effected improvements necessary for a permanent work. The terminus was at first at Huang-Ku-Tun, with a connection to the South Manchuria Railway at its station, but eventually arrangements were agreed to for the Imperial Railways of North China tracks to pass under the South Manchuria Railway, when the City station at Mukden—245 miles from Peking—was constructed in 1912.

In the meantime other railway developments were taking place; the Kalgan Railway was built north-west from Peking, by Chinese engineers—mostly from the Imperial Railways of North China—from 1905 onwards. The Peking-Hankow Railway was an old-established line, the first section having been built to Paotingfu by Mr. Kinder's staff as long ago as 1897 and 1898. The Tientsin-Pukow railway agreement was signed in 1908. The name "Imperial Railways of North China" was no longer convenient, and after the opening of traffic at Mukden the old name was abolished and that of "Peking-Mukden Railway" was adopted in 1912, as a distinct name derived fron the two principal termini. Other changes had also occurred. In 1902 the private interest in the railway was paid out and it became purely Government property. The increase of railways led to the establishment of the Board of Posts and Communications in 1905, when the old system of separate railways under Viceroys and Directors was abolished.

The fall of the Manchu Dynasty unsettled China, and unfortunately civil and military politicians still distract the country, and the Great War having likewise cut off the supply of materials and altered the financial outlook, the ten years from 1910 to 1920

saw no further extension of the Peking-Mukden Railway. But during that time there was a steady development of traffic and now—1922—the work of doubling the track from Tongshan to Shanhaikuan, 95 miles, is going on: a new branch line from Chin Hsien to Chaoyang, 84 miles, with a spur of 8 miles to a new coalfield is to be undertaken, and work is proceeding on the first thirty miles to I-Hsien, to which place construction trains are now running. Excluding new lines and works the railway mileage is 607 miles, and there are in addition 215 miles of loops and sidings.

The railway is substantially constructed, not too much so, as the economic conditions in China do not yet call for the density of traffic, nor for the amount of accommodation demanded in some other countries. The worst gradients are between Shanhaikuan and Chinhsien, where 1 in 125 had to be introduced at some places to avoid excessive first cost. The original light rails have almost disappeared: from Peking to Chinhsien—377 miles—is now laid with 85 lb. flat bottomed rails, well supported by thirteen sleepers per rail where the joints are opposite and fourteen sleepers per rail where the joints are "staggered." East of Chinhsien the rails are 60 lb., but the line will be re-laid with 85 lb. as soon as funds permit. The ballasting is broken rock for the most part and gravel for about 20 per cent. of the way only. Bridge piers and abutments are mostly constructed of concrete, and the girders are as far as possible standardised into a few spans such as 12ft., 20ft., 30ft., 60ft., 100ft., and 200ft. The majority of the girders are of the "deck" type with timber bridge tie floors. Up to 60ft. they are all plate girders, the larger spans being riveted trusses. The standard of loading now is the same as for other Government railways, Cooper's E 50.

The bridge-work is quite extensive. There are 850 bridges in all, practically 1½ per mile, and the average length of each is about 100ft. On the plain and parallel to rivers, the number is less; but over a considerable section of the railway the amount is over 200ft. of opening per mile, and on one division 217ft. The longest bridges are Talingho, twenty-four spans of 100ft.; Liukouho, twenty-four spans of 100ft. and one of 60ft.; Lanho, five spans of 200ft., ten spans of 100ft. and two spans of 30ft.; Liaoho, twenty spans of 100ft. and many other bridges of a less number of spans of 200ft., 100ft. and 60ft. Over 200 piers have been sunk by the pneumatic process.

Twenty of the principal stations have interlocked signals manually controlled. All other stations have home and distant signals locked with each other and the loop points. All trains are operated on the electric staff or tablet systems, these being used alternately to minimise risk of mistakes.

At the time the railway was opened through to Mukden the expenditure per mile amounted to only £7000 of capital plus £1500 paid out of revenue. By 1920, owing to the growing traffic, improvements brought up the capital expenditure to £11,000 per mile, all the addition having been paid for out of revenue. There has been a great change since 1914 in wages and prices, and it would be impossible now to build a similar line except for about double the money.

The railway is favourably situated, running between important cities like Peking, Tientsin, Newchwang and Mukden, in a district without canals and with bad roads. It touches the sea at several points, *i.e.*, Tangku, Chinwangtao and Newchwang and a projected harbour may yet be built at Hulutao. The mines from Tongshan to Kuyeh give a large mineral traffic.

The railway possess 168 locomotives, 391 passenger cars and 3823 goods wagons. The latter are mostly 20, 30 and 40-ton cars, and, as a rule, general merchandise is dispatched in full car loads. The total earnings in 1910 were $11,000,000, in 1915 $15,000,000, and in 1920 $23,000,000; given stable political conditions the growth of revenue will continue. In 1920 the ratio of operating expenses to revenue was 37 per cent. The annual work is represented by 4,000,000 passengers carried 450,000,000 passenger miles, and 6,000,000 tons of cargo carried 565,000,000 ton-miles.

The locomotive workshops are at Tongshan, where from 3000 to 4000 men are employed. The workshops are capable of producing locomotives, passenger cars, goods cars and boilers of good quality and workmanship. Besides filling the needs of the Peking-Mukden Railway they can supply for other railways in China annually ten locomotives, thirty passenger cars, and 400 goods wagons.

The engineering department at Shanhaikuan manufacture points and crossings, signal installations, turntables, water-tanks, pumps, girders of all spans, and all the plant required to maintain the railway and build new extensions, of superior workmanship.

The social and economic conditions in China differ much from those in England; it is neither necessary nor desirable to give all the facilities obtained in countries where railways are more developed. In some matters the Chinese railways may appear deficient, but it is impossible to go ahead of the general progress and ideas of the people, without incurring hostility and even revolution. Co-operation is the safe and steady method of advancing the interests of China now that the stage has been reached when the Chinese naturally wish to run their own affairs more than in the past. As was well expressed by Lord Balfour at the close of the Washington Conference, China's future is really in her own hands, and for the credit and advancement of China the sooner the rival civil and military politicians agree the sooner will business, finance and railways continue the advance of the past, which has been rather retarded than advanced by recent events. But whatever method of control is adopted it will not be easy to surpass the record of the Peking-Mukden Railway.

Undue competition between nations has nearly wrecked the world. The financial consortium to assist China is ready to help with railway extensions and improvements as a necessary measure of co-operation—not competition—and soon it is hoped that China will see the advantage to be gained by opening up the country by railways, leading to increasing business and employment, and that it will far outweigh any temporary drawback due to necessary protection of the money invested.

Will you allow me to say, in conclusion, that I am indebted to Mr. D. Poyntz Ricketts, the late engineer-in-chief and general manager of the Peking-Mukden Railway, and to Mr. W. O. Leitch for the data in this article, and for the views given on page 347.

Institution of Naval Architects.

No. II.*

AT the afternoon session on March 21st, the paper by Sir John E. Thornycroft and Lieutenant Bremner was the first to be discussed. It was entitled "Coastal Motor Boats ('C.M.B.'): Their Design and Service During the War." We print an abstract of it on page 345.

Additional interest was created by the fine model of a 55ft. C.M.B., lent by John I. Thornycroft and Co., Limited, by one of the explosive vessels for the torpedo launching gear, and by the original model of the stepped hydroplane made forty-five years ago by the Rev. C. M. Ramus and lent by his son for the meeting.

Captain de Villarey, of the Italian Navy, dealt with the work of the motor boat section during the war. It was found, he said, that the small torpedo boat was of the greatest value, and that, in the Adriatic, coastal motor boats carrying torpedoes were able to sink battleships of the Dreadnought type. These boats possessed the advantage of being seen with difficulty, and they presented an extremely small mark. When they attacked the Austrian battleship Budapest near Venice in daylight the boats were not observed even by aircraft. He hoped that this type of vessel would remain at about 60ft. in length, as if they were made larger they would to some extent lose the quality of "invisibility." It was desirable that this type of construction should be continued during years of peace, and that these boats should be used for racing purposes. Such a course would promote development and help to build up the light cavalry of the sea.

Mr. Sydney Barnaby said that there were three qualities in which the coastal motor boats were superior to the older type of locomotive boiler boat. The first was seaworthiness arising from greater beam and seaboard; the second, reliability of machinery equipment; and the third, that they were able to discharge torpedoes from the stern instead of from the bow. The spiral propeller, which had been the work of Sir John Thornycroft, had proved remarkably satisfactory.

Mr. John Smith explained that the Admiralty had asked for so many combinations of new things in coastal motor boats, including a species of tin opener to deal with submarines, that Thornycroft's was the only firm willing to undertake the construction of these vessels. The elastic type of hull was found to be preferable to the rigid type, and care had been exercised in the machinery equipment to obtain the lightest weight in association with high quality.

A paper was then read by a shipowner, Mr. A. C. F. Henderson, entitled "Remarks on Some of the Present-day Problems in the Design of Ships," a *précis* of which is given below.

PRESENT-DAY PROBLEMS IN THE DESIGN OF SHIPS.

The author, speaking from the point of view of the shipowner, stated that greater efficiency would undoubtedly be promoted were the designer more closely acquainted with the owners' difficulties and the owner more familiar with the problems of design. It had to be frankly admitted that in the past the responsibility for lack of such co-operation was to be laid more often than not at the door of the shipowner. The war had occasioned an interregnum or cessation of effort in connection with the building of passenger ships, but various important details had accumulated as a result of that lapse of time, and a vast amount of experience had been gained in the safe conveyance of millions of troops in ships built in pre-Convention days. The economic position of Great Britain as a mercantile nation had never been so seriously threatened as at present, and it was not only desirable, but absolutely necessary, that the fullest exchange of opinion on every question relating to the evolution of efficient ships of all types should take place.

Dimensions.—A review of the dimensions of the largest ships built during the last thirty-five years showed a gradual increase in length and breadth, and had it not been for the war, it was probable that there would have been a ship of 1000ft. in length engaged in the Atlantic service. The longest ship afloat was the Majestic, about 950ft. in length, launched in 1914. An important consideration was the availability of graving dock facilities, and dock authorities contemplating any schemes of graving docks, piers and sheds for the North Atlantic route should be guided by the assumption that as soon as the world returns to economic stability, ships of over 1000ft. in length will be built. In tables and diagrams accompanying the paper, the increase of length, breadth and draught of the largest steamships built between the years 1883 and 1914 were shown, and also the increase in the width and depth of dock entrances at Liverpool. It was to be noticed that although the breadth and length of ships had gradually increased during that period, the maximum draught had remained practically constant. A requirement of the future would be the ability to sail with draughts up to 40ft. under practically every-day conditions, and the time was now coming when the river entrances at various ports in this country and abroad would require to be deepened.

Stability.—In dealing with stability, the author said that as far as he could discover, there was at the present time no source of information from which the shipowner or designer might derive knowledge of what is considered to be a correct amount of initial stability for vessels of the following types:—

(1) Fast passenger ships which sail with practically a fixed cycle of loading between two terminal ports.

(2) Vessels of the intermediate type, which carry but little cargo in one direction and practically capacity cargoes in the other.

(3) Cargo ships which may call at a large number of ports, collecting cargo of different densities at each one.

The real crux of the matter was that our definite knowledge of the stability qualities of any ship was confined in ordinary practice to data obtained from an inclining experiment. At that point our definite knowledge ended, and although periods of roll and many other qualities might be calculated, the knowledge was theoretical and comparative only. It had long been the practice in designing passenger vessels of the intermediate type for the Atlantic trade to aim at a condition of neutral stability in the equipped or light condition. That practice had resulted in loaded conditions varying according to type of a metacentric height of from 2ft. to 3ft. In the design of the Aquitania, which was somewhat of a departure with regard to dimensions, there was considerable doubt as to the amount of initial stability that should be aimed at in order to ensure seaworthiness and comfort for passengers, bearing in mind that from the passenger point of view the ship which was too stiff might be worse to travel in than the ship which was slightly tender. The general opinion was that the dynamic stability for any angle of roll was the governing factor for seaworthiness and comfort in a seaway. The effect of initial stability was theoretical only, and could be made as small as possible to provide an "easy" roll. On paper, no doubt, this theory was defensible, but in practice it had proved to be fallacious. As actually built, the Aquitania had a metacentric height of about 4ft. 6in. in the loaded condition, and from subsequent experience that dimension had proved to be adequate, but not excessive. In the North Atlantic trade it was essential to provide greater metacentric height than would appear necessary for the following reasons:—

The ships on leaving the port of departure had large quantities of baggage and mails piled up on the weather decks, which were stowed away in the holds as the vessel proceeded down Channel. This condition was probably of no importance, as the ship, with a complement of fuel, fresh and feed water, stores, &c., was probably in her most stable condition; but before the vessel reached her destination, it was necessary as a preliminary to expeditious disembarkation to carry out in reverse order the same operation. By that time a very large proportion of the fuel, stores and water had been consumed and stability considerably reduced, and the operation, therefore, assumed quite a different aspect from a stability point of view. The opportunity for taking in water ballast to counteract the changes made was limited if excessive trim by the stern was to be avoided, as all high-speed Atlantic ships tended to trim considerably by the stern, by reason of the disposition and weight of the machinery; and in order to keep the ship on an even keel before entering port, no ballast, as a general rule, could be put in abaft about three-eighths of the length from the stem. In consequence, there was a weakened resistance to heeling through side wind pressure, which was always a serious consideration in these days of lofty and extensive superstructures, and at the same time there was the tendency for passengers to congregate on one side of the uppermost decks when nearing port. There was also a marked tendency in large liners to add weight in the passenger accommodation, which was principally in the superstructure.

It was a well-known fact that orders placed for ships to carry a specified deadweight sometimes produced unexpected results. One ship might be able to carry its deadweight, but part of it would have to be of water or some other form of ballast; another might have insufficient capacity to carry full deadweight in the form of ordinary cargo. Deadweight was generally considered as an indication of value in the buying and selling of cargo ships, and a closer study of this question in the earlier stages would bring its own reward.

The problem of stability had taken on an entirely new aspect in the last few years, owing to the introduction of oil fuel, which was carried in the double-bottom tanks. Under present-day conditions, inclining-experiment stability might have very little bearing on conditions which arose at sea. Much could be done, and was being done, to reduce free surface effects by introducing more longitudinal subdivision into double bottoms.

The question of stability in the case of intermediate vessels which were loaded down on only one-half of a round voyage, and of deciding upon the most satisfactory design for such vessels, provided a very difficult problem. Large capacity was necessary, but it calls for a fully lined ship, and with small cargoes satisfactory draught and trim was difficult to obtain. From the capacity point of view, the minimum of hold space was taken up by carrying fuel oil in the double bottom, but that practice discounted the use of these tanks for water ballast in the light condition, owing to the difficulty of disposing of the oily water. Large deep tanks might, of course, be fitted to obtain sufficient immersion to prevent possible slamming when running into a head sea, but that course had the disadvantage of rendering these spaces less convenient for cargo. In an appendix particulars of a number of types of ships were given, which, so far as stability is concerned, have proved satisfactory from the point of view of handling in port and comfort at sea.

Machinery.—Recent developments in the various types of propelling machinery had provided a wide choice for the designer, but up to the present the experience gained in the newer types had provided no sure guide as to what was the best for any particular set of conditions. While the ordinary steam-driven reciprocating engine was suitable for low and moderate powers, it was unsuitable on account of the space occupied in high-powered Atlantic vessels, and the same might be said so far of the internal combustion engine, although great progress could and would, the author believed, be made in that direction. The only two alternatives, therefore, at present available were geared turbines and electric drive deriving power from generators operated by internal combustion engines or steam turbines. There was another aspect of the question of choice of machinery which was of primary importance, and that was the difference in weight of various installations of the same power. It was somewhat of a surprise to some designers to find that the centre of gravity of machinery rose with a change from triple-expansion reciprocating machinery to single-reduction turbines.

Another important consideration was the tendency towards reduction in machinery weights. It was only natural that in the ordinary course of engineering progress, the weight of machinery and fuel per horse-power-hour should be reduced. With oil fuel and internal combustion engines, the change was very marked, and if the fuel was stowed above the double bottom, not only was the weight reduced, but the centre of gravity was raised considerably. Those facts taken in conjunction with the demand for elaborate accommodation high up in the ship, forced

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an increase in beam and consequently in cost, in order that the necessary stability might be provided. In high-powered vessels of large size, any great economy in weight of fuel made it increasingly difficult to maintain satisfactory trim and stability in all sailing conditions. Again, when good form was essential in order to attain high speeds, the shift of centres of buoyancy and flotation between light service condition and full load sailing condition rendered it necessary to make provision for large trimming facilities, whilst when it was necessary, as was often the case, to get the lightest possible even keel for entering graving docks, the position was even more difficult. The sinkage caused by the necessary weight to avoid trim by the stern was such that any reduction in draught tended to be neutralised.

Sir Westcott Abell, in opening the discussion, congratulated the Institution on obtaining for the first time on such a subject the opinion of a shipowner, and that the author had shown the advantages of that closer co-operation between designer and shipowner which was so much to be desired. The designer wanted opportunities to study the sea behaviour of ships, and on the other hand the shipowner ought to make himself acquainted with the limitations under which the designer worked and the need for compromise in nearly all problems of ship construction. It was sometimes overlooked that the size of the cargo ship was determined rather by the space required for imports into the United Kingdom than by actual weight of cargo, and the author had drawn attention to the fact that it would be a preferable plan to pay for a ship on the basis of deadweight and capacity instead of on the present system. It was hoped that the new rules of Lloyd's Register would give designers an opportunity to make a better adjustment of scantlings in regard to cargo than had hitherto been possible. He suggested that shipowners should afford greater opportunities to post graduates to go to sea and carry on research under practical conditions. Some good work had been done in Liverpool in that direction by the courtesy of the Booth Line and the Holt Line. He hoped others would follow. He would like to know when Mr. Henderson proposed that the 1000ft. liner would be in commission. He regarded it as a better suggestion than the intermediate liner, carrying both cargo and passengers. Mr. Henderson was correct about stability. It was a question he had been hammering away at for fifteen years. They must improve the dynamic conditions of the stability of the ship. Most useful work could be done by analysing the figures collected by young naval architects at sea. Trials at sea, when compared with Mr. Baker's work on models at Teddington, would give most valuable results. More work had yet to be done to ensure that a ship would remain upright when one of her compartments was open to the sea. The amount of money spent on oil engine research work must exceed half a million pounds. Shipowners had not contributed to that. It would be of advantage to the whole industry if they would support some of this research work.

Sir Kenneth Anderson said that he shared Mr. Henderson's opinion that the tendency for a growth in the size of ships would continue. There were two conditions which qualified that development. One was economic, and the other physical. In the North Atlantic trade the growth of the liner was more favourable than in the Eastern and Australian trades, which displayed a slower growth in traffic development and where the restrictions of the Suez Canal were more severe. Still, in every trade to-day there was a tendency to increase the size of ships. He hoped that the dock authorities would increase their facilities for larger ships, and not be behindhand in that respect as they had been in the past. Dealing with Diesel engines for large ships, he remarked that he thought that in order to qualify for the 32 per cent. reduction from gross tonnage for light and air spaces, it was necessary that the machinery should occupy a space equal at least to 13 per cent. of the gross tonnage. The engineer had produced a Diesel engine which, when installed, permitted of the machinery space to be about 38 per cent. less than with a steam engine of the same power. As things stood to-day, in order to secure the 32 per cent. allowance, the shipowner would have to surrender part of this advantage in earning capacity, which, but for the regulations, the marine Diesel would give him. There had always been difficulty in complying with this 13 per cent. provision, and there was a very strong case for reconsidering the figure. Broadly speaking, the reduction of the qualifying figure from 13 per cent. to about 8 per cent. would accord with the present design possibilities. Under the subdivision load line of the 1914 Convention the permeability of the internal spaces of the vessel varied from 60 per cent. for cargo up to 95 per cent. for passenger spaces. The machinery was assessed at 80 per cent. for steam and 85 per cent. in the case of internal combustion engines. Whilst, therefore, the change from steam to oil raised the permeability of machinery spaces from 80 per cent. to 85 per cent. the economy of space in the case of oil served to compensate for increased permeability. It was necessary to observe, however, that not only was the permeability of the engine-room spaces raised from 80 to 85 per cent., but that the economy in engine-room spaces effected involved an addition to the 'tween deck passenger spaces and the permeability of the spaces so added was raised, not from 80 per cent. to 85 per cent., but from 80 per cent. to 95 per cent. The most important question, that of subdivision, had not been touched upon by Mr. Henderson. It was of the greatest importance to shipping that at the earliest possible moment regulations should be framed which should be definite, simple, and of direct application, with an international scope. As a result of the Convention rules, the present position on subdivision was quite untenable.

The President pointed out that a considerable amount of Mr. Henderson's original paper had been devoted to the question of subdivision, but in view of what was going on to-day they considered it wiser to omit it.

Mr. W. G. A. Perring thought that the Suez and Panama canals would largely determine the size of ships in the future. The depth of the Suez Canal was 32ft., and that allowed the passage of ships with a draught of 30ft., while the Panama Canal had a depth of 40ft., they only had 35ft. of water on the Pacific side. That made the canals about equal as far as the big ships were concerned.

Mr. John Anderson said that he thought that shipowners ought to realise that with the acute problems before the shipping industry to-day the matters of design ought to be left to experts. He thought it would be interesting to learn whether Mr. Henderson thought it was relatively more profitable to have a vessel of 600ft., with a speed of 16 knots employed all the year round with a full passenger list, or a vessel of 1000ft., with a speed of 20 knots and having a full complement of passengers for only four months of the year, and during the rest of that time not more than was sufficient for a 600ft. ship. His own experience at sea had always shown him that ships with a long roll were better than those with a short roll and a kick at the end of it.

The whole of the morning session on March 22nd was occupied by the reading and discussion of the paper by Sir Charles Parsons, Mr. S. S. Cook, and Mr. H. M. Duncan on "Mechanical Gearing," an abridgment of which appears on page 349.

Engineer-Vice-Admiral Sir George Goodwin, in opening the discussion, said that the Institution might not be aware of the excellent work that had been done by Mr. Duncan in connection with gearing for turbines. He had made many valuable suggestions which were put into Admiralty specifications and were included in them down to the present time. Since reduction gearing had been fitted to merchant ships a great deal had been heard about the difficulties which had been experienced, and many explanations had been put forward. It was common knowledge that in warship installations the proportion of failures had been much smaller. He had given careful consideration to this question, and was not convinced that the various explanations which had been put forward accounted for the failures which had occurred. When trouble was first experienced in warships the question was taken up vigorously and conditions for the metallurgical treatment of the material used in the construction of the gearing were laid down, although the Admiralty was not inclined to be dogmatic on the subject. They had been extremely fortunate in the Navy as the result of what had been done, and failures had been singularly few. With regard to the possible cause of failure, he would like to draw attention to one or two points. There were the pinion teeth and the wheel teeth, and whatever load or stress one set of teeth had to bear the others had also to withstand the same load. It was suggested that want of alignment might be the cause of some of the troubles that had occurred, as it would have the effect of reducing the bearing surface and causing a higher intensity of pressure. In that case the load on the wheel teeth was precisely the same as on the pinion, and the stresses would be almost the same. After much thought he had been brought to the opinion that most of the later failures were due to defects in the material. It was one of two things: either want of uniformity in the material or the fact that the mechanical properties which were required had been destroyed during the heat treatment. With regard to the suggestion that greater accuracy in the gearing was required, he was not altogether in agreement, and hoped that the solution of the difficulty did not rest on that. It was very difficult and expensive to maintain a high degree of accuracy in gearing under service conditions, and he hoped that the remedy for existing troubles, when found, would enable marine engineers to use machinery which would stand up to its work without it being necessary to strive for too great a degree of accuracy in the gearing.

Mr. H. Ruck-Keene (Lloyd's Register) said that the authors' experiments on the effect of the heat treatment of oil-quenched nickel steel pinion shafts were interesting. From them they had come to the conclusion that oil quenching of the nickel steel pinion shafts should be discontinued. He concluded, therefore, that they did not approve of the specification agreed upon by the steel manufacturers of the forgings in July last, as in that specification it was stated that after boring and rough turning the shafts should be submitted to heat treatment which included quenching in oil. Lloyd's Register had issued this specification for the information of those members of its staff who had to survey these shafts during construction. It had, however, been made quite clear that whilst the specification was considered satisfactory, it was not in any way compulsory, the opinion being held that the correct heat treatment of nickel steel pinion shafts was a matter which should be dealt with by steel manufacturers and metallurgists rather than by a classification society. He could quite understand that with solid nickel steel pinion shafts, many of which had been fitted on merchant vessels, the heat treatment of nickel steel forgings might produce strains of extreme severity; but in view of the excellent results obtained in the Royal Navy with oil-quenched hollow steel shafts, he was at a loss to understand why equally good results had not been obtained in similar gears in merchant vessels. He would be glad if the authors of the paper could give an explanation and state whether they considered that in future nickel steel pinion shafts should be used without any heat treatment even if they were bored hollow, and, if not, what steel they proposed in place of nickel steel for pinion shafts. All engineers fully recognised how much the world was indebted to Sir Charles Parsons for the introduction and the wonderful development of turbines and turbine reduction gears, and they looked for his help in solving the present trouble.

Engineer-Commander Onyon referred to the case of the Italian liner Conte Rosso, in which the double-reduction gear had given considerable trouble, which, had, however, been overcome, and the vessel was now working quite satisfactorily. It had been suggested that it was necessary to secure flexibility in the geared turbine installation, but that, he held, was going in the wrong direction. His experience led him to believe that there was nothing wrong with double-reduction gearing, and that if it was efficiently designed it would always be successful.

Dr. W. H. Hatfield said that co-operation which had now been brought about between engineers, shipbuilders and metallurgists had resulted in a good deal of light being thrown on the problem. He had no hesitation in saying that the essential cause of failure in reduction gears was that the gears were submitted in service to stresses which the designer never intended they should have to withstand. There were two methods suggested of tackling the problem: One was to eliminate the causes of excessive stress, and the other to introduce a softer steel, which would deform readily and so prevent the stresses which would otherwise be produced. Therefore the problem resolved itself, as he understood it, into hard *versus* soft steel for the gears. The paper contained an account of experiments, but he did not think the experiments were at all conclusive. He would point out that the hardening and tempering of steel was an operation demanding high technique, and he would say quite definitely that the authors had not succeeded in reproducing in their experiments the hardening and tempering operations to which pinion forgings were subjected in steel works. He therefore proposed to eliminate their evidence. He could assure the meeting that all the steel makers concerned had taken precautions against any pinion forging going out of the works unless it had a clean bill of health. With regard to the suggested introduction of soft steel for pinions, that must be done on the responsibility of the man who desired to employ it. It was impossible to disregard the fact that nickel steel had many advantages, the most important of which was its great resistance to wear when compared with mild steel, and it would be generally agreed that wearing properties were extremely important in this particular case.

Mr. Wyberg said that in Ljungstrom turbine practice considerable experience of reduction gears for ship propulsion had been gained, and a number of these gears had been in use on turbo-electrical installations as well as on ordinary geared turbine machinery. In these geared turbine plants, reversing was effected by epicyclic gearing. Three ships with this type of machinery were in service, and the first of them, the Pacific, had run 110,000 sea miles without any defects being revealed. In developing suitable material for the gearing they had been helped by their experience of the material employed in the rotors of Ljungstrom turbines, where heat-treated high-tensile steel was used for the blade rings. They had found it imperative in that case to use a material not too hard and brittle after quenching and before tempering. To produce this result the upper limit of the carbon content should be 0.3 per cent.—even if as low as 3 per cent. nickel were used—and should a higher percentage of nickel be desired, the carbon must be reduced, having due regard to the other ingredients of the steel. The importance of correct composition was revealed by the fact that the only case in which they had experience of a defective pinion was found to be due to a variation in the composition of the steel from that given in the specification. It was important that the base of the gear case should be of small dimensions so that the area in contact with the ship's structure was reduced to a minimum. When this was done elastic deformation of the ship's structure did not to any great extent affect the alignment of the pinion. The gear casing should be made as stiff as possible. He was of opinion that the rigid mechanical gear system was simpler and as good as the floating frame.

Dr. Smith, in a long contribution to the discussion, agreed that unless the experimental work of the paper was supported by the experience of the expert steel metallurgist he had doubts of it possessing real value. It was important to remember that there were two sides to this question. In an ideal arrangement the marine engineer would desire to have a ductile material, but at the same time a hardened surface.

In his opinion the association of hard pinion teeth with soft wheel teeth was the best compromise. He had investigated a large number of cases of gearing in which excessive wear of teeth had occurred quite apart from turbine drives. Experiments on the effects of a high periodicity critical state had been made on a mild steel pin 1in. long, 1in. wide, ¼in. thick, and it had been found that it was possible to remove one-third of the material in twenty minutes, the action being accompanied by the peculiar roar of a bad reduction gearing. A series of experiments carried out on these lines, using different kinds of steel in the primitive, the normal, and the hardened states would, he believed, throw a good deal of light on failures in reduction gears. He had been associated at Workman, Clark's with double-reduction gearing installations representing 120,000 horse-power of propelling machinery, and with regard to the general position he might say that he had knowledge of at least forty failures last year in double-reduction drives. The phenomenon of blade shedding was also a serious one, there being a number of cases in which that trouble had been repeated frequently. Investigation had shown that in all these cases the higher critical speed of the system coincided with the speed of one of the turbine shafts. There could scarcely be any difference of opinion as to the importance of greater accuracy in gear cutting, but he would point out that periodic irregularities in gears were a result of the very nature of gear-cutting machinery. The only method of dealing with inaccuracy in gearing was elasticity. In a "nodal" arrangement such as had been suggested elements were connected to the other elements of the system by means of long elastic connections of the simplest character, with the object of allowing for effects of inaccuracies of the gearing wheels. The "nodal" drive was in direct opposition to the damped spring drive referred to in the paper, and his experience indicated that damping arrangements were unnecessary. He had been led to the conclusion that the effects which produced flaking, pitting and fatigue fractures were the same as those which produced blade shedding, and that a dynamical system designed to overcome one of these troubles was a cure for all. He would like to add, in conclusion, that in his own practice he had not met with any trouble from bad steels.

Mr. J. Wilkie said that the main point raised in the paper was rather a question for the metallurgist than the engineer, but very little of practical value could be deduced from the results quoted. The primary pinions in the Melmore Head were of nickel-chrome steel, oil-quenched and tempered. They were new when the "nodal" drives were fitted, and to-day, after two years' continuous service, were in perfect order. Equally good results were to hand from other vessels fitted with this arrangement. Experiments by Dr. Hatfield had not only proved that fractures could be produced in gearing steel forgings by repeated stresses in one direction, but that a hammering effect in one direction might result in a smashing of perfectly good material. It was this hammering effect, whether arising from irregularities due to imperfect gear cutting or fluctuating load on the propeller which must be eliminated, and there was now ample proof that that could be achieved by the "nodal" arrangement. One point emerged from the interchange of opinion which had taken place; it was that definite flexibility ought to be introduced between the turbines and the gearing in order to provide for the errors which would creep in even with the greatest possible care in manufacture.

Mr. Service expressed a feeling of disappointment with the paper. Nothing new had been revealed, and the data given as to the experiments were so scanty that no satisfactory conclusions could be drawn. The authors had apparently started out to prove that nickel steel could be cracked during the process of treatment, a fact which was well known to all steel makers. In order that a proper analysis of the mechanical tests could be made and proper conclusions drawn, it was essential that the actual chemical composition of the sample should be given. He assumed that the mechanical tests had been taken after the last heat treatment, and if he was correct in that assumption it was difficult to explain the difference in mechanical tests. It was well known to men who were accustomed to heat-treat nickel steel forgings of large mass that with a certain carbon and manganese content the material was more liable to cracking than similar forgings of lower carbon and manganese content. The authors were not entitled to assume that, because wheel rim teeth did not break, it was because the steel had been normalised; the only conclusion one could draw from the result set out was that the wheel rims were less severely stressed than the pinions. The authors' suggestion for heating the steel to a temperature slightly above the upper critical point and allowing it to cool in air would probably add to the trouble of tooth breakages the further trouble of the internal cracking known as "clinking." He would suggest to shipbuilders and engineers that they made frank confession of the fact that they did not know the stresses to which the pinions were subjected under actual service conditions, and that being so, what they wanted was a tougher material with an elastic limit as high as possible. The engineer would be well advised to cut out of his specification chemical composition and heat treatment details and insist on much higher mechanical properties.

Mr. R. J. McLeod said that the question of the advisability of having hardened pinions in a gear train was, of course, a matter of individual opinion, but his experience did not support the view that a hardened pinion lasted longer than an unhardened one. One thing the experiments brought out very clearly was that in dealing with double helical pinions made of nickel or nickel-chrome steel there was an ever-present risk of cracks developing during the process of each treatment. His firm last year had to supply a large number of pinion form cutters to customers in the United States, and as the question of delivery was urgent they sent a number of cutters to Sheffield steel makers to be hardened and tempered. Of these cutters a large proportion cracked, and it was quite clear that there was an element of uncertainty as to the behaviour of the material. Homogeneity of the material was of far greater importance than high physical qualities. It was questionable whether oil or air hardening was worth the attendant risk, and he was inclined to agree with the authors that heat treatment should either be abandoned or be confined to normalising the forging. It was the duty of the manufacturers of the gears to be continually seeking out remedies for the troubles that had arisen, and his firm had spent a considerable amount of time and money to bring gearing to a high state of perfection.

Mr. R. Walker contended that the subject under discussion was a matter for the engineer as well as the metallurgist. As Sir George Goodwin had said, they had in Mr. Duncan a metallurgist for the experimental work. He would like to assure Dr. Hatfield and steel makers generally that they had nothing against nickel steel, but they did feel, as a result of experience, that for turbine gearing it was necessary to use a softer material. Wheel rims had withstood the same stresses as the pinions, but the rims did not fracture and the pinions did. That seemed an unanswerable argument.

Sir Charles Parsons, in a brief statement, emphasised the fact that for the special purposes of the marine geared turbine the hard steels which had been used must be regarded as unsuitable. He did not think that sufficient attention had been given to the difference between hardening large objects and small objects. When a large mass of steel was quenched in oil it would remain hot at the centre when the outside was quite cold. This was not so in the case of a small article, in which the whole mass was lowered in temperature and stress was not introduced. Motor car gears, which were hardened in small masses and had to withstand severe stresses, had proved satisfactory; but in any event he would point out that the breakdown in a motor car was not so serious as in marine service. He and those who had worked with him had reached the conclusion that they must discontinue the use of hard steels as soon as possible. As far as they were aware there was no case of a soft pinion having to be renewed from wear of the teeth. The cost of pinions, after all, was not large, and even if they had to renew the pinions every time a vessel went under survey it would not be an expensive business.

Mr. Stanley Cooke, referring to the question of torsional oscillation, said that could not be accepted as the explanation of the increasing percentage of gearing failures during the last year or two in merchant ships, in view of the comparative immunity of warship installations in which torsional oscillation must be considerable. One or two speakers had defended hard steels, but he and his fellow-authors had come to the conclusion that soft steels were to be preferred. They must go back to the ductile steel, which they advocated following the early experiments with the Vespasian. It was the measure of the resistance of the material to deformation which was of real importance, and not tensile strength or the limit of proportionality.

Mr. H. M. Duncan also emphasised the fact that softer steels should be used for the pinions. If, however, that was the view of some marine engineers, there was by no means agreement amongst steel makers on the point, and some among them were even advocating the use of harder steels than those now employed up to a tensile strength of 50 to 55 tons. Referring to Dr. Hatfield's criticism, it was true that he had had no experience of the heat treatment of large masses of steel, but he had been associated for fourteen years with an iron and steel works, and was very familiar with the general methods of heat treatment. He would also point out that before they started their experiments they obtained definite information from a well-known Sheffield firm on the subject of the proper heat treatment to give nickel steel pinion forgings.

Australian Engineering Notes.

It was stated by the *Melbourne Argus* a short time ago that, realising that adequate modern port accommodation is essential to the progress of the State, the Wardens of the South Australian Harbour Board have embarked upon a vigorous policy of addition and improvement, and hope to have their programme fully carried out in two years.

Four years ago the Board officials drew up a programme of works for the improvement of the main harbour and outports of the State. The restrictions of expenditure during the war period, however, prevented them from carrying out their designs, but the realisation of the Wardens' hopes is approaching. The proposals are set out in the Loan Estimates of 1922–23 for the South Australian Harbours Board, and the sum of £850,000 is allocated. It is hoped by the Wardens to have the full programme of new works and reconstruction completed at the end of the year.

One of the most vital proposals to oversea shippers contained in the Wardens' report and provided for in the Loan Estimates, is the widening and deepening of the port river wharves in view of the heavier tonnage of vessels now being built abroad. The river level at dead low tide is now from 27ft. to 29ft., while at the outer harbour a depth of 33ft. of water is available at low tide. This compares with 34ft. at Prince's Pier, Port Melbourne.

The work of dredging will be finished, it is estimated, in two years. More deepening plant is being purchased by the Board, and tenders are being called for the supply of a floating crane for Port Adelaide. A good deal of money has been spent in rebuilding some of the wharves previously held by private companies under lease from the Government. Several of the approaches to the sheds and wharves are to be wood blocked, and more sheds will be built. Another question of great interest to shippers—that of the provision of sufficient coal-handling appliances—is under consideration. More A.G.A. lights are being installed at hazardous spots on the coastline. Like Melbourne, Adelaide is sorely in need of cranes on the wharves and jetties, and although nothing definite was promised to a recent deputation, it is confidently expected that before long action will be taken to facilitate the loading and discharge of steamers in this respect.

Of the money provided for harbour improvements, much has been spent on outports. At Port Lincoln, on the west coast, a jetty which cost £45,000 was put into service in January. It carries four sets of railway lines, and gives a depth of 34ft. of water at low tide, with a 7ft. tidal rise, thus enabling large oversea steamers to load to capacity instead of topping off at Wallaroo as before. Improvements have also been made at Stansbury, Port Julia, Coobowie, Ardrossan and Balgowan (Yorke Peninsula), and at Point Elliston and Cape Thevenard (Eyre Peninsula). An addition at Haycock Point is a much-needed jetty, and another pier is in course of construction at Antechamber Bay, Kangaroo Island.

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The Melbourne City Council has conferred with representatives of the Electrical Federation of Victoria upon the question of bringing electricity into more general use in the household. As a result, the Council has decided to make available electric current at a low rate for domestic use, with a view to widening the field for the sale of electricity. It also purposes obtaining samples of the best types of cooking and other domestic appliances in use throughout the world, in order that practical demonstrations may be given. Under the new municipal schedule, power will be made available at a maximum of 1½d. per unit.

* * * * * *

The Cabinet some few weeks ago appointed Mr. C. Kinnimouth, chief grain-handling expert for Henry Simon, Limited, of Manchester, to inquire into and report on the maize-handling scheme for North Queensland. Mr. Kinnimouth recently considered the co-operative grain elevator scheme for the West Australian Government. The Queensland plan is designed to obtain better markets for the immense quantities of maize which can be grown on the Atherton tableland. Mr. Kinnimouth's report will deal with the problems of drying, cleaning and storing. Pooling arrangements may also come into operation.

* * * * * *

It is reported in Sydney that the Government is likely very shortly to take steps in connection with the proposal for a high-pressure tunnel, estimated to cost £1,450,000, in order to improve the city's water supply. The tunnel will take about five years to construct.

* * * * * *

Enhanced activity is expected in the Zeehan district of Tasmania in consequence of the Mount Lyell Company's intention to increase the production of pyritic ore and the reported formation of a new company to work afresh the extensive copper and nickel lodes at North Dundas after a cessation of eight years.

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It is reported from Melbourne that important ore discoveries have been made in the Zeehan district in Tasmania, and that development work has been started on the main lodes, which lie to the north-west of the township. The line of country pegged and taken up is approximately one and a-half miles in length by one mile wide. The *Industrial Australian* learns that the directors of the Monarch Tin Mining Company have exercised an option over the Monarch Tin Mine at Mt. Cameron (Tas.), and have instructed that the mine and plant be taken over at once. Despite the fact that operations were hampered by the closing of the smelting works at Cockle Creek, mining operations in the Goulburn district of New South Wales in 1922 showed some improvement in values as compared with the preceding period. Altogether, 294,756 oz. of silver, 1035 tons of lead, and 621 oz. of gold, valued at £64,630 were recovered, an increase of £13,468. A company styled Tower Hill Consolidated N.L., with a registered capital of £45,000, in 20s. shares, is being formed in Tasmania. It is proposed immediately to erect a winding plant and to install a boiler, compressor and rock drills. The Lloyd George Mine at Gibraltar, south-west of Coolgardie (W.A.), is opening up so satisfactorily, says the *West Australian*, that it has been decided to supplement the Huntingdon mill by erecting a ten-head battery.

* * * * * *

The serious decline in gold production in Australia in recent years has prompted the various interests concerned to undertake policies calculated to stimulate the output. In some instances drastic economies have been effected in order to bring costs of production within the value of the comparative light yields from the ground under treatment, but of greater importance are the efforts which are being made to open up new fields or to give venturesome spirits an opportunity to re-test existing fields.

A Seven-Day Journal.

Future of Woolwich Arsenal.

Of the various proposals made some time ago regarding the development of Woolwich as an industrial centre, or, alternatively, of extending the scope of the work placed at the Arsenal, we have heard very little recently. It does not follow that the position in the neighbourhood has become settled or in any respect more satisfactory than it was. The opposite rather is true, for uncertainty still prevails as to whether the Government means to maintain the National Ordnance Factory at Woolwich or remove it to some other situation where it would be less exposed to attacks from the air in time of war. The matter was raised in the House of Commons a few days ago when the Army Estimates reached the report stage. It was asserted by one speaker that the workpeople at the Arsenal had now been reduced to an extent which brought the total some thousands below what was deemed necessary to meet calls for immediate expansion, and that men with thirty to forty years' experience were being discharged without pension or compensation. The Financial Secretary to the War Office, replying to the remarks made, dwelt on the fact that arrangements had been made to place sufficient Army and Navy work at the Arsenal to keep the number of men now employed there on full time. A great improvement, he added, had been made in connection with the overhead charges, and a committee had been set up to deal with the re-arrangement of the shops, so as to promote still greater efficiency. The minimum establishment for the Arsenal was now considered to be between 6000 and 7000 men. As for the removal of the factory to another site, he could only reassure those concerned in the matter that the cost involved would be so great that the proposal could not be entertained at present.

The Navy and the Royal Air Force.

ALTHOUGH the agitation in favour of the Navy securing complete and undivided control over the aircraft co-operating with it has died down for the time being as a result of the Government's promise that the whole scheme of defence is to be reviewed by a special committee, interest in the question is not being allowed to fall off. Replying recently to a question in Parliament, the First Lord of the Admiralty stated that the numbers of the different classes of machines allocated to the branch of the Royal Air Force operating with the Navy were as follows:—Fighters, 6; bombers, 0; reconnaissance, 18; spotting, 18; torpedo planes, 12. The fact thus revealed that the Navy has no bombing machines has created surprise in some quarters, and has been used to reinforce the argument that under the control of the Air Ministry the Navy is not receiving its due in aeronautical equipment. Those who comment thus may perhaps be reminded that for some time past it has been strongly held in naval aeronautical circles that the correct course to follow is to concentrate on the development of torpedo planes, for it has been demonstrated that for attacks on ships such machines are very much more effective than bombers. The absence of machines of the latter category is not a sign that the Navy is being starved, but is distinctly an indication of progress.

Electrical Power Engineers.

FOLLOWING the threat of "national drastic action" by the engineering and technical staffs employed in power-houses, the Minister of Labour arranged a joint meeting last Friday of the employers' representatives and of those of the Electrical Power Engineers' Association. The conference was resumed on Saturday, and after a sitting extending over more than six hours it was announced that an agreement had been reached whereby the deadlock which had arisen had been removed. The original cause of the dispute was the dismissal of the engineers employed by the Halifax Corporation following upon proposed reductions of salaries, but the basis soon widened, and was made to include questions of national negotiations and the recognition of the Association's schedule of wages and conditions. In the course of the dispute, the National Joint Board for the electricity industry ceased to function, but as a result of last Saturday's agreement it has been re-established, and will now proceed to deal with the detailed points of the trouble. It is thus evident that the dangers of a national stoppage are merely postponed.

Overtime and Night-Work in Shipyards.

ALTHOUGH the overtime, night shift and holiday work agreement was signed in London on Thursday of last week by the negotiating committee of the Federated Engineering and Shipbuilding Trades and the representatives of the Shipbuilding Employers' Federation, the labour outlook in the shipyards is still by no means clear of possible trouble. The men accepted the terms of the agreement on a ballot vote, which theoretically is binding on all the unions and societies affiliated with the Federated Trades. Actually, however, the votes recorded for and against acceptance represent a very small minority of those affected by the agreement, while, in two instances—the boilermakers and the woodworkers—the unions as a whole abstained from taking part in the ballot, and intimated that although they were members of the Federated Trades they would not be bound by the result of the voting. Nevertheless, it has been intimated that the terms of the agreement are to be applied to all sections immediately, so that the possibility of trouble is clearly prominent. Under the agreement, overtime by time workers is to be paid for at the rate of time and a-half, while piece workers are to receive an additional payment of 25 per cent. based on the average hourly earnings. For work done between Saturday midnight and Sunday midnight double rates are to be paid to time workers and an additional 50 per cent. payment is to be made to piece workers; while for night-shift work additional rates of 66 per cent. and 25 per cent. are to be paid to the two categories respectively. The agreement is to remain in force for three years, and is terminable by either side by six months' notice in writing. The boilermakers have found the terms so unsatisfactory that, following their refusal to take part in the ballot, they have decided to withdraw from the Federated Trades.

Electrical Litigation.

Two legal cases of more than passing interest to the electrical industry arose or were disposed of during the week. In one, the British Thomson-Houston Company sought an interim injunction against George Hunt, of Birmingham, with the object of restraining him from selling tungsten drawn wire and half-watt lamps, infringing the company's patents. The defendant's counsel admitted that the company's position was secure as regarded the leading-in wire and half-watt patents. The validity of the drawn wire patent was, however, he added, challenged, and the defendant, backed by the manufacturers in Holland, was anxious to fight the action. The motion was allowed to stand over in order that the defendant's counsel might ascertain whether the Dutch makers would allow themselves to be added as defendants to the action. In the second case, Marconi's Wireless Telegraph Company, Limited, appealed against Mr. Justice Lawrence's judgment in the action brought by the company against the Mullard Radio Valve Company, Limited, for infringement of patents in connection with thermionic valves. Defendants denied infringement. They admitted that they had made and sold considerable numbers of thermionic valves, but had done so in part as agents or contractors to the Admiralty. They further pleaded that the plaintiffs' patents were invalid for want of novelty and subject matter. The Appeal Court unanimously affirmed Mr. Justice Lawrence's judgment to the effect that the defendants had not infringed the plaintiffs' patents, but that, their attack on the validity of those patents having failed, they should pay the costs involved by that attack, the general costs of the action being borne by the plaintiffs.

London Dock Extensions.

REPLYING in Parliament on Monday, the Parliamentary Secretary to the Ministry of Labour gave some particulars of the work which the Port of London Authority proposed to carry out with Government help in order to relieve unemployment. The works included, it was stated, deep-water docks and an impounding station in the Surrey Commercial Docks and a new deep-water dock, a new entrance lock and a new dry dock at Tilbury. The schemes would at first provide employment for some 900 men, and ultimately for about 4500. The precise form of financial arrangement to be entered into in connection with the scheme is still under discussion.

A Large Water Power and Wood Pulp Scheme.

DETAILS of a very large and noteworthy scheme for the development of hydro-electric power and its utilisation for the production of wood pulp and paper in Newfoundland have been received this week. The scheme, known as the "Humber-arm Proposition," involves the development of an initial 100,000 horse-power at a point on Deer Lake on the west side of Newfoundland and the erection of pulp and paper mills capable of turning out 400 tons of newsprint per day. A dam 75ft. high and 1200ft. long will be required. The whole contract will be carried out by Armstrong, Whitworth and Co., the turbines, &c., being made at Elswick and the paper-making plant at Bury by Charles Walmsley and Co.—a firm now intimately associated with Messrs. Armstrong. The scheme has been approved for guarantee by the Trade Facilities Act Advisory Committee to the extent of £2,000,000, provided the Newfoundland Government will guarantee an equal sum. That Government is about to take the country's opinion on the matter. Meanwhile, Messrs. Armstrong have put preparatory works in hand. It is intimated that the energy will be transmitted from the generating station to the mills at 6000 volts, and will be used to the extent of 60,000 horse-power for the generation of steam for cooking the pulp and drying the paper, and as to about 30,000 horse-power for the mechanical operation of the mills.

Reduced Grants for Scientific Research.

PARTICULARS of the estimated sums to be expended by the Department of Scientific and Industrial Research during the coming financial year, published on Monday, show apparent signs of the pruning knife. The total net estimate amounts to £276,863, and represents a decrease of £20,574 as compared with the figure for the current year. Of the various sections on which the money is expended, the Geological Survey is alone in showing an increase, the sum allocated to that service being £53,456, or £1409 more than for this year. The greatest absolute decrease is shown in connection with the expenditure estimated for the National Physical Laboratory, the figure for which, £164,060, is less by £20,243 than that for the year now closing. The greatest relative decrease, however, is set against the Fuel Research Board, the estimated allowance for which, at £34,560, is £16,819 less than that for 1922–23. More than half the reduction set against the Board is accounted for by reduced salaries and allowances, while some £6000 has been cut off the sum to be expended upon the provision of experimental plant, &c., at East Greenwich. At the National Physical Laboratory reductions of salaries and allowances account for a saving of £17,000 odd, while about £3000 is to be saved on equipment and stores. The apparent discrepancy between these figures and that given for the aggregate decrease is to be accounted for by the fact that allowance has to be made for variations in the appropriations-in-aid, which appropriations in the year now closing were estimated at £140,000. These receipts are derived from fees charged by the National Physical Laboratory for testing work, from the sale of by-products by the Fuel Research Board, and from other sources of income.

Southampton Floating Dock.

GOOD progress, we learn, is being made with the construction of the 60,000-ton floating dry dock, which Armstrong, Whitworths are building for Southampton, the first section—No. IV.—having been launched towards the end of last week. A full description of the dock appeared in our issue of October 20th last year. It is of the double-sided self-docking sectional box type, with pontoons and two parallel walls divided transversely into seven sections. It will have a lifting power of 60,000 tons, and an overall length of 960ft., and will be capable of receiving the largest war or mercantile vessel built or in contemplation. The first plates were laid on the blocks on November 22nd last, and the total weight of material worked in up to the present date is about 8000 tons. The dock is being constructed under the supervision of Mr. H. A. Butt, the resident inspector of the designers, Messrs. Clark and Standfield.

Sixty Years Ago.

SIXTY years ago the mechanical theory of heat was far from being generally accepted. It was to most people as elusive and abstruse and apparently unnecessary as Einstein's theory of relativity is to many to-day. In our issue of March 27th, 1863, we reprinted a paper read before the Manchester Literary and Philosophical Society by Mr. J. C. Dyer, whose object was to uphold the old belief that heat was something material which had the power to unite with or dissociate itself from other bodies. "If it were true," we read, "that acting forces always produce their equivalent in heat, then the powerful movements of railway springs, hydraulic presses and the like should raise intense heat in the steel springs and water exerting such force and the absence of any heat in such cases, must be fatal to the dynamic creation of heat." It is with great interest that we notice a footnote to this passage in which our then editor, Mr. Zerah Colburn, stated that he had experimentally determined the thermal effects of compressing or dilating metals and fluids, and had found these effects to be strictly in accordance with the dynamical theory of heat. At the same meeting of the same society, Mr. Crookes exhibited a specimen weighing 450 grains of the new metal thallium, which he had discovered by spectrum analysis, and had isolated from deposits found in the flues of pyrites burners. Dr. Joule also contributed to the proceedings by describing a new form of delicate thermometer depending upon the action of currents of air on finely suspended magnetic needles. The sensitiveness of the device was claimed to be such that it could detect the heat radiated from the moon.

The Inchinnan Bridge at Renfrew.

THE new rolling lift bridge spanning the river Cart at Renfrew, which has been built for the Corporation of Paisley, by Sir William Arrol and Co., Limited, was officially opened for traffic on the afternoon of Wednesday, the 21st inst. The present bridge not only marks the beginning of a new and happier phase in the history of the Cart as an industrial and shipbuilding river, but it is the largest of its type in Scotland, and represents a class of bridge which is likely to find increasing use in connection with the various road schemes which are now occupying the attention of the Ministry of Transport.

HISTORICAL NOTES.

The first attempt to bridge the rivers Cart and Gryffe at Inchinnan was made in 1759, when a bridge of ten arches, 775ft. long and 19ft. wide, was built to span both rivers. This structure collapsed in the spring of 1809 following heavy floods. Between the years 1809 and 1812 a second bridge built in two parts—three centre arches and two small spans over the Gryffe and three main arches over the Cart—was completed, and still remains in service. When in 1784 the first attempt to deepen the Cart was made, under an Act enabling the magistrates and town council of Paisley to improve the navigation of the river, a canal cut crossing the main turnpike road from Glasgow to Greenock was made. This navigable channel was constructed east of the former channel, and over it was thrown a structure well known in the West of Scotland as the Inchinnan swing bridge. This bridge, which has now been replaced by the more commodious and modern one we are about to describe, was notable for its many faults. There was only a single track for vehicles, with an extremely narrow carriageway of 14ft. wide, while the limit of load was 3 tons, which effectually barred much of the modern traffic.

An even more serious disadvantage was the restricted waterway of a little over 48ft. in width, which limited the size of vessels that could be built and launched in the Cart shipyards. The unanimous opinion concerning the inadequacy of the old bridge to meet modern requirements was strengthened by the bad state of repair into which it fell during recent years, and eventually—largely owing to the initiative of the shipbuilders on the river Cart—a project for a new bridge was launched. The adverse financial position of the trustees of the Cart Navigation, and the absence of an administrative body representing that authority, made it very necessary that the cost of the new undertaking should be shared by the various parties concerned. A Provisional Order was granted to the Paisley Corporation, empowering it to proceed with the construction of the new bridge and relative works, the cost being shared as agreed between the Burgh of Paisley, the County of Renfrew, the Ministry of Transport, the Burgh of Renfrew, and the Cart shipbuilders. The Burgh of Paisley will be responsible for maintaining the bridge. The navigation of the Cart and the upkeep of the channel still remains in the hands of the trustees of the Cart Navigation, and we understand that the river will very likely remain derelict, unless the bondholders decide to spend money on the deepening and improvement of the channel.

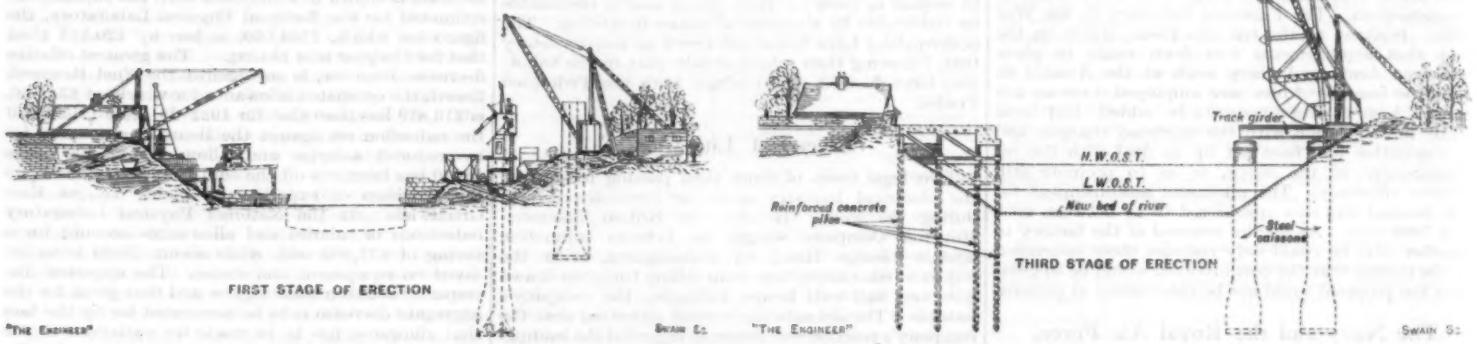


FIG. 1—STAGES IN THE ERECTION OF INCHINNAN BRIDGE

THE NEW OPENING BRIDGE.

The work of designing and erecting the new structure was entrusted to Sir William Arrol and Co., Limited, Glasgow, and we are indebted to the firm and its resident engineer, Mr. J. Shannon, and to Mr. James Lee, the burgh engineer of Paisley, and Mr. J. J. Burrowes, his resident engineer, for the series of illustrations which accompany our description.

Operations were begun in July, 1921, when a temporary bridge—see page 342—was thrown over the river about 130 yards up stream to accommodate traffic during the demolition of the old bridge and the construction of the new one. This was a traverser bridge, operated by a small petrol driven winch, and it was ready for traffic on September 1st, 1921. The work of demolishing the swing bridge was commenced shortly after this date, and by the beginning of June, 1922, the foundations were ready to receive the steel work. Owing to labour troubles and the engineers' lock-out, some delay was caused in the supply of material, and it was not until October that the actual steel structural work was begun. The new bridge was completed early this month, and the whole undertaking has occupied a period of about twenty months.

The progress of the work is clearly illustrated by the series of photographs reproduced on page 342 and in Figs. 2, 3 and 4, while the sketches shown in Fig. 1 indicate the three chief stages in the erection.

The bridge—shown in detail in Fig. 5—comprises one opening span, one track span, and one abutment at each end, along with the machinery houses. The opening span measures 99ft. to the centre of the bearings, and when open gives a clear waterway between the timber fenders of 90ft. From the centre of the front pier of the track span to the face of the Renfrew or east abutment is 36ft. 8in., and there is an additional length of machinery house foundation of about 25ft. The Paisley or west abutment is about 40ft. 10in. in length, and the total length of the bridge is 201ft. 6in.

Foundations. — Referring to Figs. 1 and 5, it

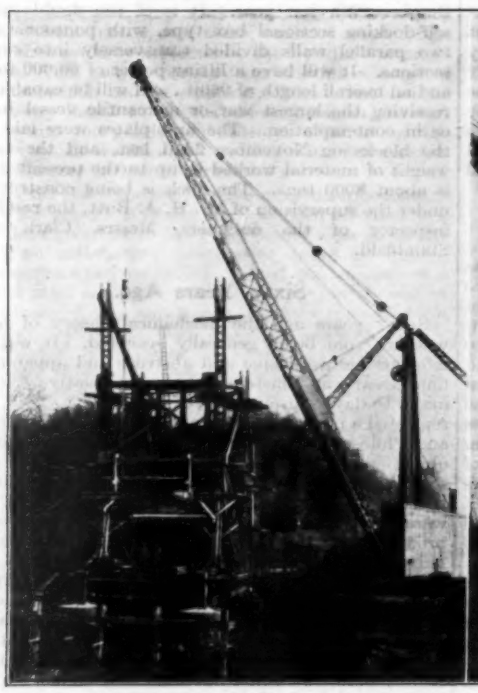


FIG. 2—ERECTION OF OPENING SPAN

FIG. 3—OPENING SPAN COMPLETED

FIG. 4—OPENING SPAN RAISED

will be noted that the west or Paisley abutment is constructed with reinforced concrete piles. These piles were provided with steel shoes and were driven to a depth of about 42ft. below the bottom of the new river channel. The roadway surface of both abutments is composed of 4in. tar-macadam laid on concrete, and the surface of the footway is formed with Granolithic. The foundations for the track span had to be designed with special reference to the heavy concentrated loads caused by the weight of the opening span. In this case steel cylinders, 9ft. diameter at the top and 14ft. diameter at the foot, were sunk under air pressure to a depth of about 45ft. The work of sinking the four cylinders was carried out without a hitch, and a firm foundation on boulder clay was reached, after which the cylinders were filled with concrete and firmly braced together in pairs with heavy diagonal and horizontal steel frames.

The Track Span.—On the top of the caissons are mounted the two main track girders, each of 29ft. 8in. span and 6ft. in depth. The top flanges of these girders are furnished with milled cast steel track plates, which are bolted to them, and form a track for the opening or rolling lift span. For the purpose of keeping the span in exact alignment, teeth are provided in the track plates, which correspond with similar recesses in the rim or track plates of the quadrant girder. The floor of the track span is carried on cross girders attached to the webs of the main track girders, and the roadway floor is formed of 4in. tar-macadam laid on the concrete filling over the buckled plating of the floor system. On the east abutment there are also the machinery house foundations and anchorages. They are constructed on reinforced concrete with steel grillages and foundation bolts for the machinery trestles.

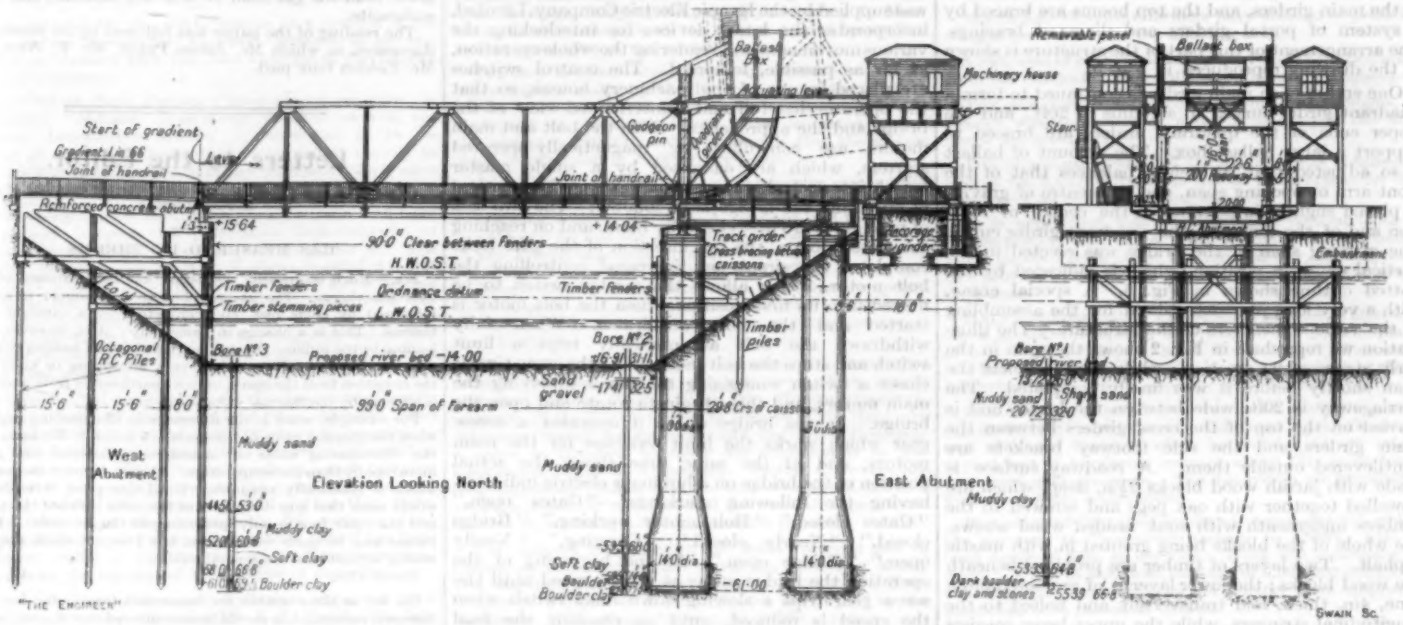


FIG. 5—GENERAL ARRANGEMENT OF INCHINNAN ROLLING-LIFT BRIDGE

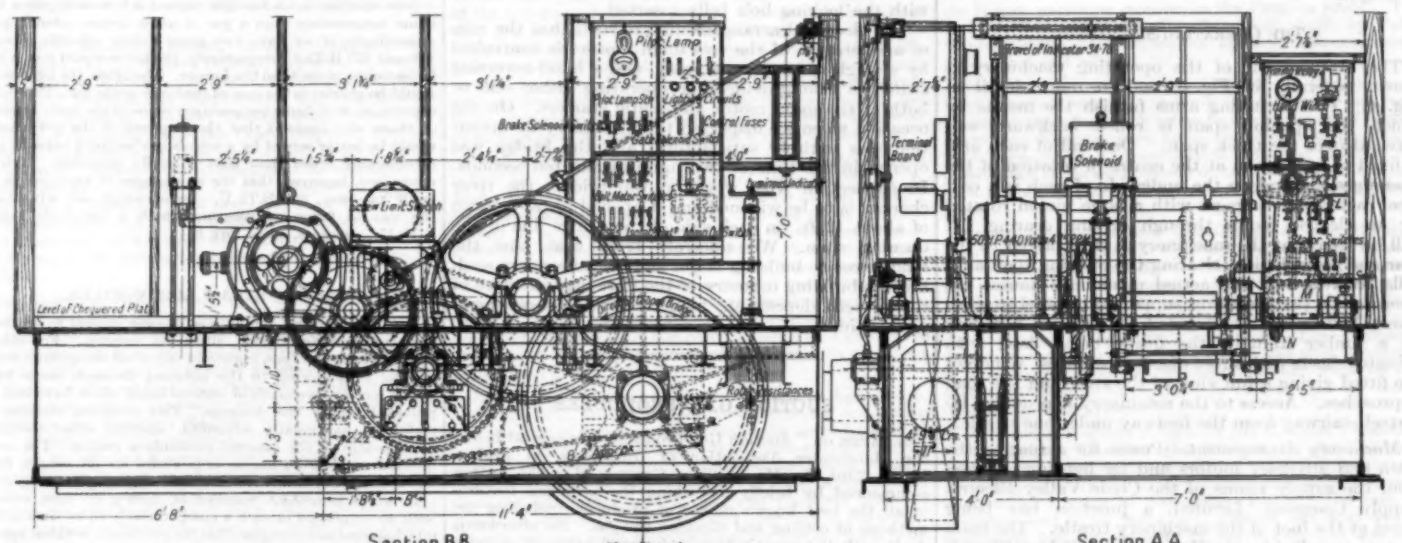


FIG. 6—OPERATING MACHINERY OF INCHINNAN BRIDGE

Particulars of Gearing

Wheel	Pitch Diam.	Revs/Min.	No. of Teeth	Pitch	Width Face	Bore	Remarks
A	8·33"	47·5	25	No 3	4¼	2⅞	M.S. Machine Cut
B	36"	11·0	108	No 3	4"	5⅛	C.S. " "
C	10·5"	11·0	21	No 2	5½	8⅜	M.S. " "
D	42"	27·5	84	No 2	5½	5½	C.S. " "
E	12·8"	27·5	16	No 1/4	8"	8"	M.S. " "
F	58·8"	6·2	71	No 1/4	8"	9"	C.S. " "
G	17·9"	6·2	15	3¾"	11"	9"	M.S. " "
H	68·87"	1·66	56	3¾"	11"	13⅜	C.S. " "
J	26·75"	1·66	14	6"	13"	3¾"	C.S. Moulded
K	5·66"	Assume 20	17	No 3	3"	1⅝"	M.S. Machine Cut
L	16·66"	6·6	50	No 3	3"	7"	C.I. " "
M	9·5"	6·6	19	No 2	3·5"	5"	M.S. " "
N	18·5"	9·5	37	No 2	3·5"	9¾"	C.S. " "

Particulars of Shafting

Shaft	R.P.M.	Diam.	Dia. of Bear.	Length of Bear.	Overall Length
Motor	475	2⅞"	2⅞"		
1st Reduction	110	3¾"	3½"	5"	10' 9½"
2nd "	27·5	6·5⅜"/6·5	5"	7½"	6'·0"
3rd "	6·2	9"/8·8"	8"	6"	4'·4⅜"
4th "	1·66	14"/13⅜"/8"	14"/8"	13⅜"/8"	7'·2"
Cross Shaft	27·5	5"	5"	7½"	14'·1½"

The Opening Span.—This part of the bridge is of the rolling lift or rim bascule type, and consists essentially of two main lattice steel girders, each 99ft. long and 20ft. deep. The floor of the span is carried on cross girders attached to the bottom booms of the main girders, and the top booms are braced by a system of portal girders and diagonal bracings. The arrangement of this part of the structure is shown in the drawing reproduced in Fig. 5.

One end of each main girder is continued to form a quadrant girder curved to a radius of 20ft., and the upper ends of the quadrant girders are braced to support a large ballast box. The amount of ballast is so adjusted that its weight balances that of the front arm or opening span, and the centre of gravity is placed slightly in advance of the centre of rotation and of the centre of the quadrant girder curve. The opening span of the bridge was erected in the vertical or open position, which is indicated by the dotted outline shown in Fig. 5. A special crane, with a very long jib, was utilised for the assembling of the various members of the structure. The illustration we reproduce in Fig. 2 shows the span in the early stages of its erection; while Fig. 3 depicts the span shortly before it was finally completed. The carriageway is 20ft. wide between the kerbs, and is carried on the top of the cross girders between the main girders, and the side footway brackets are cantilevered outside them. A roadway surface is made with jarrah wood blocks 2½in. deep, which are dowelled together with oak pegs and screwed to the timbers underneath with sunk headed wood screws, the whole of the blocks being grouted in with mastic asphalt. Two layers of timber are provided beneath the wood blocks; the lower layer is of creosoted pitch pine, 4in. thick, laid transversely and bolted to the longitudinal stringers, while the upper layer consists of creosoted white pine having a thickness of 3in., which is laid diagonally and spiked to the lower timbers. The side footways, each of 5ft. minimum width, are formed of 3in. creosoted white pine laid transversely and spiked to longitudinal timbers bolted to the steel footway brackets. These footways are furnished with handrails 3ft. 9in. in height.

The Operating Machinery.

The arrangement of the operating machinery is shown generally in Fig. 5, and in more detail in Fig. 6. Two actuating arms furnish the means by which the opening span is rolled backward and forward over the track span. One end of each arm is fixed to a gudgeon at the centre of rotation of the opening span, and on the underside of each is a cast steel rack which engages with a large pinion rotated by an electric motor through driving gearing. It will be seen that the machinery is thus placed to the rear and to each side, clearing the opening span as it rolls backwards. The actual machinery houses are mounted on two platforms supported on steel trestles. These houses are constructed of weather boarding on a timber framing, the inside being lined with asbestos sheets with a roof of asbestos slates. Windows are fitted giving a full view of the river and the road approaches. Access to the machinery is provided by a steel stairway from the footway under one trestle.

Machinery Arrangement.—Power for actuating the main and auxiliary motors and for lighting is taken from the supply mains of the Clyde Valley Electric Supply Company, Limited, a junction box being fitted at the foot of the machinery trestle. The main motors, supplied by the Metropolitan-Vickers Electric Company, Limited, are each designed to develop 50 brake horse-power when supplied with three-phase 25-cycle alternating current at a pressure of 440 volts. The motor which operates the bridge bolt, along with its reduction gearing and crank, is a 1½ brake horse-power machine running at a speed of 680 revolutions per minute from the same supply. Each main motor is designed to operate the bridge under normal conditions of wind loading assumed at 5 lb. per square foot, and under these conditions the time to open or close the bridge completely by one motor is three minutes after the locking of the gates across the roadway. The two motors coupled together are capable of operating and controlling the bridge under a wind load of 20 lb. per square foot. An automatic electric brake of the solenoid type is provided on each motor shaft, and is so arranged that it is released immediately current is applied to the motors, and grips immediately current is cut off or when for any reason the supply fails. Each brake is designed to be capable of stopping or holding the bridge in any position. A further emergency brake, controlled by a hand wheel and screw gear, provides a means of holding the bridge in any position under a wind load of 40 lb. per square foot. Pneumatic buffers are fixed to the nose end of the lift span, so as to absorb any shock which it might sustain as it is being lowered on to the nose bearings.

In each machinery house there is a hand gear for opening or closing the bridge by manual power. This gear is connected to the second motion cross shaft by means of bevel gearing and clutch. By means of this arrangement, in the event of any electrical failure, the bridge may be opened and closed by two men in eighty minutes or by four men working simultaneously on both sets of gears in forty minutes. These hand gears are equipped with a foot operated brake, and there is also a hand lever arrangement provided for operating the bridge locking bolt.

The Electric Control Gear.

The control gear for the motors and gates, which was supplied by the Igranic Electric Company, Limited, incorporates the latest devices for interlocking the various movements and rendering the whole operation, as far as possible, foolproof. The control switches are placed in one of the machinery houses, so that the operator has full and uninterrupted view of the bridge and the approaches. Both the bolt and main motors are controlled by magnetically-operated starters, which are energised by a single master switch interlocked with the road gates. The method of operating the bridge is as follows:—The two sets of road gates are first closed by hand, and on reaching the closed points, the full insertion of the gate locks completes the circuit on the panel controlling the bolt motor, which allows the master switch to be moved into its first position, when the bolt motor is started and the bolt withdrawn. When fully withdrawn the bolt automatically trips a limit switch and stops the bolt motor. At the same time it closes a switch energising the panel supplying the main motors, and these begin to rotate and open the bridge. As the bridge opens it operates a screw gear which works the limit switches for the main motors, and at the same time shows the actual position of the bridge on a luminous electric indicator, having the following markings:—"Gates open," "Gates closed," "Bolt motor working," "Bridge closed," "Nearly closed," "Coasting," "Nearly open," "Bridge open." At the beginning of the operation the bridge opens at a high speed until the screw gear trips a slowing down limit switch when the speed is reduced, until on reaching the final limit switch the motors are stopped and the motion of the bridge is arrested by the solenoid brakes.

For closing the bridge the cycle of operations is reversed, a single master switch only being used for the main and bolt motors. The automatic locks on the road gates are released by a switch in the machinery house, which cannot be operated until the bridge has reached its position for road traffic with the locking bolt fully inserted.

The electrical arrangements are such that the rate of acceleration of the two main motors is controlled by a single time element relay, and a hand reversing switch is also provided for operating either one or both of the main motor automatic starters. On the occasion when we inspected the machinery its operation was entirely satisfactory, and the bridge was opened in the time of two minutes and ten seconds. In connection with work on the bridge, the river channel is to be widened and deepened for a distance of about 125ft. on each side of the centre line of the opening span. We sincerely trust that now the hindrances to building larger ships has been removed, the shipbuilding industry of the Cart may, in spite of the present depression, look forward to more prosperous times.

SUCTION GAS PRODUCERS.

A paper on "Suction Gas Producers" was read before the Manchester Association of Engineers on Friday, March 23rd, by Mr. William Greenwood. The author commenced by briefly describing the principal features of all the best known makes of producer, including the methods of cooling and cleaning the gas. He afterwards dealt with the constitution and classification of suitable fuels, and concluded by pointing out the lines which the future development of the suction gas plant will probably follow. These include the propulsion of the motor vehicle and marine vessels. Speaking of fuels, the author said there was every indication that the use of refuse fuel for gas production would become more extensive in future owing to the cost and difficulty of disposing of this refuse by other means, as well as the increasing cost of better kinds of fuel Although the results now obtained were very good, there would certainly be greater developments in future. Two of the materials in this category which the author mentioned were spent tan and cotton seed husks, the calorific values of which were as high as 4000 B.Th.U. and 4500 B.Th.U. respectively.

Speaking of the special types of gas producers for bituminous coal and refuse fuels, he remarked that extensive experiments had been carried out by many gas plant makers, and adopted by some, with other types, such as the downward draught producer, in which air was drawn down through the fire; the double-draught producer, where a portion of the air is drawn in through the top of generator and the remainder drawn through the bottom, the gas outlet from the generator being fixed about the centre; the reverse draught producer, in which two separate fires or two separate generators were used so that the air was drawn up one fire and down the other. These types were introduced principally for the purpose of endeavouring to burn the volatiles in the producer instead of taking them off with the gas and afterwards separating them by other means. There were different opinions regarding the removal of the tarry vapours in the producer itself or allowing them to leave the producer and be removed by tar extractors, but some success has been obtained in producing a gas free from tar by means of the double-draught type of producer in which the fuel was put in at the top and the upper part of the fire burns downwards. In that way the hydrocarbons were distilled off and various useful reactions occurred. When bituminous coal was being used the coke which was made fell gradually to the lower part of the producer and was then converted into ordinary producer gas by the upward current of air and steam which was drawn in at the bottom. When an ordinary quality of bituminous coal was being used, or several other varieties of fuel, it was claimed that the tar was converted into fixed gases in the producer and no mechanical tar extractor was required. Mr. Greenwood said the quality of gas from that type of plant was rather lower than the gas from an ordinary suction plant using anthracite.

The reading of the paper was followed by an interesting discussion, in which Mr. James Paton, Mr. F. West, and Mr. Fielden took part.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

GAS MEASURED BY THERMS.

Sir,—Much interesting discussion has been aroused of late over the therm. The gas supplied to a consumer is always measured by cubic feet, and converted, by a constant, into therms. This is a change in name only; it is, however, misleading to the public. Most of our lighting and heating depends on incandescence. It would be very interesting to know how the radiation from the stove, or more particularly from a mantle, is affected by the thermal value of the gas.

For example, what is the difference in illuminating capacity when the thermal value of the gas is 4.5 or 3.5? We know that the illuminating value of incandescing material rises much more rapidly than the temperature. At least, through the portion which is practically available. Until this point is settled, it would seem that any discussion of the ratio between the therm and the cubic foot is only misleading to the consumer. These values may be quite well known, but I do not think they are readily available to the general public.

March 17th. W. A.

[So far as the constant for conversion from cubic feet into therms is concerned, it should be remembered that it is one which varies with each of the gas undertakings, and that it is dependent upon the "declared calorific value" which rules in a particular area. The light given by an incandescent body at high temperatures is proportional to the twelfth power of the temperature, so that a small rise in temperature is followed by a considerable increase in the light emitted. Our correspondent would seem to have fallen into the very common error of assuming that flame temperature varies in direct proportion with calorific power, whereas in effect a gas of moderately low calorific power—providing the incombustible content is low—will give a higher flame temperature than a gas of much higher calorific power. Accordingly, if we have two gases having calorific powers of 450 and 350 B.Th.U. respectively, the latter would give a higher flame temperature than the former. Therefore, the light emitted would be greater in the case of the lower grade gas. This point in connection with flame temperature is one of the main arguments of those who contend that the interests of the gas consumer would be better served by a town's gas having a calorific power considerably lower than that normally provided. It is now recognised, however, that the advantages of supplying a high-grade gas—say, 500 B.Th.U.—far outweigh any advantage in the way of flame temperature which a low-grade gas—350 B.Th.U.—presents.—Ed. The E.]

NOISY STEAM LOCOMOTIVES.

Sir,—The general public has become critical in matters of engineering design which affect its comfort. For example, the motor car has been improved out of all recognition from its original form, owing to the insistent demands made by the public for improvements of various kinds which have had to be provided for by the designer. This continual striving after perfection has greatly advanced, amongst other things, the development of the internal combustion engine. The modern internal combustion engine is powerful for its weight, flexible and economical, and it is also practically noiseless in operation.

It seems somewhat remarkable, having in view what has been accomplished in such a comparatively short time with the internal combustion engine, that the public can, without apparent protest, accept the discomfort and inconvenience with which even the most modern steam locomotive afflicts us. The average main-line railway station has at any time usually one or more locomotives, either starting with a deafening open exhaust, or else standing by with steam escaping from the safety valves. The discomfort occasioned by such conditions must affect thousands daily, but possibly custom has dulled their critical faculties into accepting such things. One may wonder, however, what the effect would be if a locomotive equipped with a Diesel engine were allowed to create the same disturbance.

To steam engineers, who no doubt still have faith in the continued existence of the steam locomotive, the solution of this problem of noise should provide an interesting field of research, and its satisfactory solution would remove at least one reproach from what may be regarded as one of the most reliable, but probably least efficient, prime movers in the world.

L. J. Le Mesurier.

London, W.C. 1, March 22nd.

BALL VALVES.

Sir,—I have been searching for some particulars about ball valves, but have been unable to find them, and turn to your readers for help. We all know that for an ordinary poppet valve the maximum opening is given when the lift of the valve is equal to one-fourth of the diameter of the opening. What I want is the proper lift for a ball valve. I shall feel obliged if someone can give me the formula for calculating it.

March 26th. W. D.

Some time ago it was reported that steps were being taken to work marble quarries in the Langkawi Islands, which lie off the coast of Kedah, one of the Unfederated Malay States. Official information is now to hand to the effect that a mining lease has been issued for certain land at Pulo Langkawi, where investigations have shown that there is an appreciable amount of copper. It is reported that tin-ore has been discovered near Kluang, in the centre of the State of Johore.

Railway Matters.

COMMENCING on Monday next, the 5.30 p.m. from King's Cross will call regularly at York, Darlington and Durham.

THE contract for the electrification of a portion of the Great Indian Peninsular Railway, referred to in this column on January 26th, has been awarded to the English Electric Company.

THE Chilean State Railways have placed an order for twenty-five "Mikado" type steam locomotives with the Baldwin Locomotive Works. Construction is to be started at once, and the engines forwarded as rapidly as they are turned out. The company purchased thirty-nine electric locomotives in the United States last year.

THE Abergele local authorities required some land from the railway company for promenade improvements at Pensarn, and offered 5s. per square yard for it. The London, Midland and Scottish Railway wanted £1, but agreed to accept 15s. The Council asked for a further reduction, but was hardly prepared to hear the other day that, having regard to the fact that the land was required for the development of the place the company would give the land on the nominal payment of £1, on condition that it was used solely for the widening of the promenade.

AT the annual meeting of the Underground Electric Railways Company, Lord Ashfield, the chairman, said they were interested in 66 miles of railway, carrying in 1922, 325,000,000 passengers; in 1778 miles of omnibus routes, covering 722 miles of roadway, and carrying 924,000,000 passengers; and in 117 miles of tramways, carrying 186,000,000 passengers. Altogether they were, in one way or another, responsible for carrying 1594 millions of passengers, or much more than half of the local passenger traffic of London, for which they were concerned with the running of 191,000,000 of car miles.

THOSE traders who supply railway companies with material and stores will miss Mr. J. J. Smith, the late stores superintendent of the North British Railway, who has retired. In his speech at the annual meeting, Mr. Whitelaw, the chairman, said of Mr. Smith: "I have been in the closest personal touch with Mr. Smith's work from the day I joined the board, and together we have striven—with some success, I think—to buy the best material at the lowest price. As he retires, Mr. Smith may well be proud in the knowledge that the chief stores superintendent of the London and North-Eastern Railway Company will be one who was trained at Cowlairs under himself."

THE West Somerset Mineral Railway Company was authorised in 1857 to make a railway, 11¼ miles in length, from the pier at Watchet. It has an authorised capital of £105,000, all of which has been created, but only £85,969 have been expended. It was worked until recently by the Ebbw Vale Steel, Iron and Coal Company, but has for years been run at a loss, and a Bill is now before Parliament to abandon the railway and to sanction the winding up and dissolution of the company. At an extraordinary meeting of the proprietors on March 28th the Bill was approved. Such a step was evidently anticipated when the Railways Act was drafted, as it is not included among the railways scheduled in that Act to be absorbed.

THE suggestion has recently been made that the few remaining second-class bookings will be abandoned, and that the third-class then will be called second-class, and there will be only first-class and second-class. We do not think that this is likely to happen at present. One practical reason is that second-class bookings to and from the Continent are almost necessary, and as long as they are retained by the Southern Railway there must be third-class. A difficulty of another sort is that most people object to be labelled "second-class," although, strange to relate, they do not mind being "third-class." They regard "second-class" as a compromise; neither one thing nor the other, and say if they cannot be first-class they are content to be third. Why, too, should the change be made? It means a vast expenditure on paint and printing.

THE collision on January 6th at New Cross, L.B. and S.C. section of the Southern Railway, between a Metropolitan electrically operated train and an engine and van has been reported upon by Major Hall. This officer's report, recently issued, says: "The signalman in the Yard box no doubt largely relies upon the measure of security provided by the block instrument, fouling bar and signal locking as a substitute for direct observation of the road and his own memory. This reliance is quite natural, and it is indeed largely in order to relieve signalmen in busy boxes, such as this is, from the necessity for close observation of the road and the memorising of all movements that automatic safeguards are provided. Unless, however, they are reliable and complete, their presence introduces an element of risk, and there is always a possibility that, sooner or later, they will be relied upon under just the set of conditions in which they are inoperative."

THE following are the further changes in the chief mechanical engineer's department, London and North-Eastern Railway:—Mr. A. J. Hills, who has been with the Great Eastern Railway for forty-six years, retires to-morrow, March 31st; Mr. W. Chalmers, chief mechanical engineer, North British Railway, becomes mechanical engineer, southern Scottish area, and Mr. T. E. Heywood, locomotive engineer, Great North of Scotland Railway, is to hold the similar position for the northern Scottish area. Mr. A. C. Stamer is to be Mr. Gresley's chief assistant, ranking as chief assistant mechanical engineer, with office at Darlington; Mr. F. Wintour becomes assistant mechanical engineer, southern area, with office at Doncaster; and Mr. C. W. L. Glaze and Mr. R. Thom are the district mechanical engineers at Stratford and Gorton respectively. The running services are separated from the upkeep, and Mr. J. H. Smeddle becomes running superintendent at York for the North-Eastern area, and Mr. W. G. P. Maclure, with office at Liverpool-street, for the southern area. Mr. Heywood takes the running along with the upkeep for the North Scottish area. Mr. O. Bulleid is to be assistant to the chief mechanical engineer.

Notes and Memoranda.

THE new radium factory at Oolen, near Antwerp, where radium is henceforth to be extracted from the ore brought from Katanga, Belgian Congo, will, according to Mme. Curie, be able to supply all the radium needed by medical men in every part of the world.

THE New Zealand Government engineers are investigating a request made by the Egmont Power Board for a licence to develop 2000 horse-power at Taranaki on the west coast of the North Island. The estimated cost of the project is £60,000, and it is claimed that the scheme could be extended to 20,000 horse-power.

CONCLUDING some remarks on hydraulic stowing for coal mines, at a recent meeting of the Manchester Geological and Mining Society, Mr. A. J. A. Orchard said that a few months ago he had the opportunity of hearing the views of two French engineers from the Saar district, who were on a tour of inspection in this country. They stated that hydraulic stowing was not resorted to except for special reasons, such as spontaneous combustion or support of the surface, and that as an ordinary working practice it was too costly.

WITH a view to developing commercial processes for reduction of the complex sulphide ores which are so abundant on the Pacific Coast, Mr. Howard Freeman, secretary of the British Columbia Branch of the Honorary Advisory Council for Scientific and Industrial Research, is going to Montreal to carry out experiments in the laboratories of McGill University. British Columbia has long entertained hopes that its iron ores would prove a valuable industrial resource, and the research experiments referred to are being aided by subsidies from the Council.

THE deepest rotary-drilled oil wells recorded are in California, according to the American Bureau of Mines. The Standard Oil Company drilled a test well in Kern County to a depth of 6240ft. A well was drilled in the Kettleman Hills, Kings County, to 6602ft.; rotary tools were used from the surface to 3500ft., cable tools from 3500ft. to 4070ft., and rotary tools from 4070ft. to 6602ft. It is common practice to drill holes with rotary tools in California to depths greater than 4000ft. The Producers Oil Company, in the Humblepool, Texas, drilled a hole with rotary gear to 5410ft.

IN the course of a paper read before the American Institute of Mining and Metallurgical Engineers, Mr. W. R. Bean said that the deterioration of malleable iron in the hot-dip galvanising process is intimately associated with the amount of phosphorus and silicon in the iron. When both the phosphorus and silicon are low, the malleable iron will withstand the process best with practically no deterioration. High-phosphorus and high-silicon irons are practically certain to be embrittled by galvanising, but if the phosphorus is about 0.10 per cent., the silicon may be as high as 1.20 per cent. without serious trouble.

IN the course of a paper on railway electrification, read before the Engineering Institute of Canada, Mr. A. L. Mudge gave an account of some accidents on the Chicago, Milwaukee and St. Paul Railway. Among them was one, caused by a landslide, in which two electric goods locomotives on the Coast division rolled 400ft. down an embankment. Nine men went over with the locomotives, two of these men were injured seriously, but all recovered. The parts of the locomotives were brought back to the shops on twenty-one flat cars, the motors themselves being uninjured. The railway company rebuilt both locomotives at a cost of 90,000 dollars, and they are now in operation on the road in as good condition as ever.

IN Bulletin 1098 of the U.S. Department of Agriculture, 1922, Mr. D. L. van Dine describes a method of controlling the breeding of malaria mosquitoes in the lower Mississippi Valley. In this region the bayous or shallow streams of the delta, with their accompanying vegetation, greatly facilitate the breeding of anophelines. The topography renders drainage impossible, and a trial was therefore made of clearing a section of the bayous and impounding the water, so as to convert what was practically a marsh into a lake. The essential points in this method are the preliminary clearing of all vegetation, the provision of a sufficiently high permanent level of water to suppress the further growth of aquatic and semi-aquatic vegetation, and the maintenance of a clean margin. The experiment thus carried out is stated to have given good results.

AN official statement just issued and referred to in the *Iron and Coal Trades' Review* confirms the persistent rumours that the lignite briquetting experiments which have been in progress for many months at Bienfait, Sask., have proved a failure in commercial operation. A conference of the representatives of the three Governments financially interested in the operations of the Lignite Utilisation Board—those of the Dominion, the Province of Manitoba, and the Province of Saskatchewan—was held with the members of the Board in the office of the Prime Minister of Manitoba, at Winnipeg. As a result of the conference and the unfavourable reports presented thereat, it was agreed that a trial should be made of a carboniser developed by the Bureau of Mines at Washington, and that, if found satisfactory, this should be substituted for the carboniser at present in use at Bienfait.

AN article in the *Engineering News-Record* describes how the concrete jackets which were put on wooden piles, to protect them from marine borers, were themselves penetrated by rock-boring mollusks, and concludes as follows:—It is entirely to be expected that, when rock borers have penetrated the concrete jacket about a wooden pile, wood borers will be able to gain entrance through the pholad holes and attack the pile itself. There is also a more serious possibility in the case of reinforced concrete piles; a single borer penetrating such a pile would let water in to the reinforcing metal, which would effect corrosion and swelling of the latter, causing the pile to crack and speedily disintegrate. It appears, at any rate, that the use of concrete for marine construction is not so immediate and certain a solution of the marine borer problem as has sometimes been assumed to be the case. Engineers will await with much interest further observations on the permanence of concrete in sea water, as affected by borer action.

Miscellanea.

IT is proposed to establish an engineering society for Walsall and district.

SOUTH LINCOLNSHIRE farmers have decided to press for a sugar beet factory in the Spalding area.

A NEW vein of copper has been discovered about two miles from the celebrated Parys Mountain mines in Anglesey.

THE discovery of an important oilfield at Limogne, in France, was announced at a recent meeting of the Académie des Sciences in Paris.

THE Municipal Council of Ootacamund has obtained a loan of Rs. 3,65,000 from the Indian Government for the purpose of an electric lighting scheme.

IT is understood that the Canadian Westinghouse is contemplating building a great power plant at Seaton Lake, on the Pacific Great Eastern Railway, to sell power to a proposed pulp mill at Squamish and to Seattle power consumers.

HALF a million dollars will be spent at New Waterford, Nova Scotia, this spring, according to the present plans of the British Empire Steel Corporation. The work involves the construction of a new power plant at New Waterford Lake, with a capacity of 5000-kilowatts.

THE Western Australian Government mining engineer reports having visited the site of the recent gold discovery east of Mount Shenton, where he found a narrow interrupted belt of auriferous country about fifty miles long, with good gold prospects. The discoveries are promising, but as yet quite undeveloped.

IT is reported that the Canadian Government will widen the entrance to Vancouver harbour to 1200ft., with a least depth of 35ft. at low tide. Work will commence in April. A Bill to authorise the loan of 5,000,000 dollars to the Harbour Commissioners for further port improvements has been passed at Ottawa.

WE are asked to say that the April issue of the official *Journal* of the Institute of Cost and Works Accountants, "The Cost Accountant," which will be published on April 5th, will contain a verbatim report of the proceedings of the Second Annual Costing Conference, on the subject of "Standardisation in Cost Accountancy."

WITH the departure from Southampton, yesterday, of the New Zealand Shipping Company's Rotorua, 12,500 tons, there has entered the New Zealand passenger trade the largest passenger steamer on the Panama route. The Rotorua was originally the Shropshire, built by John Brown and Co., Ltd., Clydebank, and has been completely overhauled and refitted.

SEVERAL new water-power schemes for Canada have been reported recently. Among them there is one from Timmins, Ontario, which refers to the diversion of Grassy River into Kenogamissee Lake, to develop an additional 5000 horse-power. Investigations are being made of the possibilities of the water-power on the Back River, Quebec, with a view to developing from 45,000 to 50,000 horse-power.

ALTHOUGH the second installation of the Bombay hydro-electric scheme will be ready and in service, according to the *Indian and Eastern Engineer*, within the next few months, a further increase in demand for supply has warranted a third project being taken up by Messrs. Tata and Sons, and floated as the Tata Power Company, and construction has already commenced. The combined output of the three companies will be just over a quarter of a million horse-power. Provision is being made for the three installations to operate in conjunction by interconnecting their systems.

IN the course of the debate on the Colonial Estimates in the Belgian Chamber, the Minister for the Colonies, gave some interesting figures relating to the Belgian Congo, according to which the export trade of the Congo last year approached a value of 500 million francs. The rate of exchange had to be taken into account and that was a drawback, but the quantity of goods exported was encouraging. The quantities of 45,000 to 50,000 tons of copper, 250,000 to 300,000 carats of diamonds, and 3000 kilos. of gold which it was expected would be exported in 1923, showed a remarkable rate of production.

EXTENDED tests of a new type of steam boiler known as the "Atmos" boiler, have just been completed at Gothenburg, Sweden, the inventor being Mr. Victor Blomqvist, a mechanical engineer of Stockholm. The basic principle is that the tubes, straight and of unusually large diameter, are kept constantly rotating at 330 revolutions per minute about their longitudinal axis. This is said to force the steam bubbles instantly towards the centre of the tube, because of the centrifugal action of the water. The walls of the tubes are thus constantly covered with a layer of water, and there is the greatest possible transmission of heat. The tubes are rotated by a steam turbine or electric motor, driving through a gear train.

THE Leipzig correspondent of the *Boersen Courier* says that the Leipzig Fair, affected by the Ruhr occupation and unfavourable monetary conditions, yielded but a poor economic result. The number of visitors is considered to be a record, but a considerable proportion of them came for the purpose of obtaining information rather than of buying. In spite of the large foreign contingent, some of the former regular frequenters of the Fair were absent, Australia, for example, being almost unrepresented. Not all the expected visitors from North America put in an appearance, some of them having apparently made purchases in France instead of in Germany. French and Belgian buyers were naturally extremely few. British representatives did a comparatively good amount of business, and Czechoslovakia sent a rather large number of buyers. The reductions in price expected by customers at the Fair did not take place generally, although in certain branches, such as the shoe industry, prices were lowered by as much as 25 per cent. Demand was chiefly for ready goods, which could be sold at firm prices. Business was irregular. While some sections did an acceptable amount of trade, others were dissatisfied. The total result, according to the journal quoted, must be characterised as mediocre.

ROLLING-LIFT BRIDGE AT INCHINNAN, RENFREW

SIR WILLIAM ARROL AND CO., LIMITED, GLASGOW, ENGINEERS

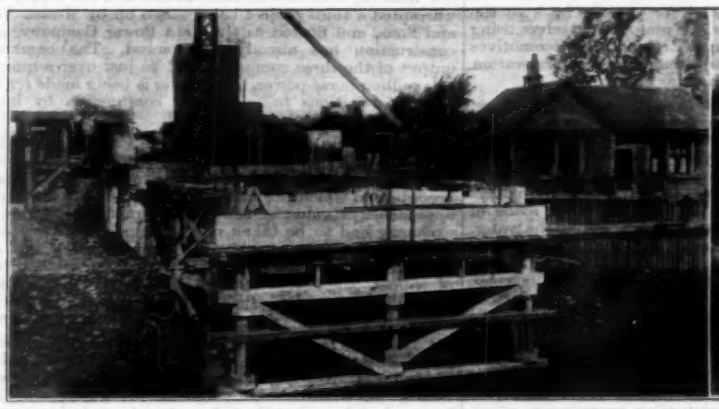
(*For description see page 338*)

THE OLD SWING BRIDGE WHICH HAS BEEN REPLACED

TEMPORARY BRIDGE FOR USE DURING OPERATIONS

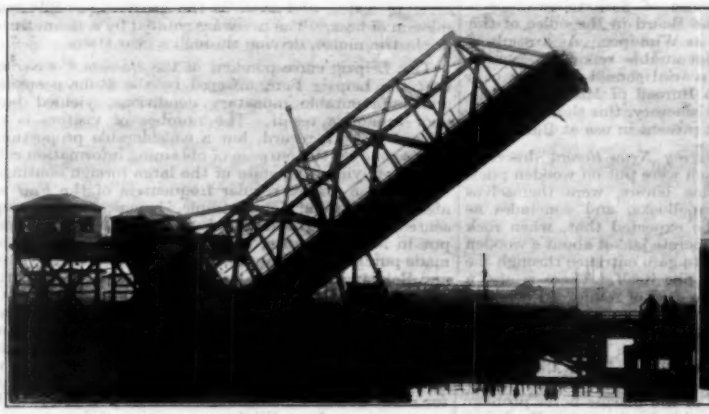
SINKING PIER CYLINDERS

FOUR CYLINDERS SUNK INTO POSITION



REINFORCED CONCRETE APPROACH ON WEST BANK

TRACK GIRDERS AND ROADWAY DECKING



THE NEW BRIDGE HALF RAISED

THE NEW BRIDGE IN LOWERED POSITION

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The Engineer

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THE ENGINEER.

MARCH 30, 1923.

Engineering and Agriculture.

DURING the past five years agriculture in France has been passing from a purely manual occupation to an engineering enterprise. The change is being brought about by the scarcity of labour and the high wages, which occur at a time when every effort is being made to produce, as far as possible, all the foodstuffs needed for home consumption. The importation of foreign labour has only palliated the difficulty without removing it, and it is now generally recognised that there is little hope of increasing the area of land under cultivation until something is done to improve the conditions of agriculture and bring down farmers' costs with the aid of cheap motive power. At first it was proposed to supply that power with the aid of alcohol, which was to be sold to agriculturists at a very low price. A closer inquiry into the country's resources in alcohol showed that there was little hope of relief in that direction for a long while to come, and the Minister of Agriculture therefore carried out an active propaganda in favour of rural electrification, whereby it is believed that the conveniences offered and the raising of the standard of labour generally will attract a good class of men back to the land. As a matter of fact, the electrification of farms is expected to give an industrial character to agriculture. The farms will be equipped with power for every operation, even for the cultivation of land, and men with the training necessary to take charge of electrical installations and of machinery actuated by electrical energy will be required. The considerably larger output of each man will enable the farmer to pay higher wages and probably offer the same advantages as those which are at present attracting labour into the purely industrial centres. It is only when agriculture can induce a class of agricultural mechanics to return to the land that it will be possible to give a much greater development to the industry. Of late years additional schools have been established in France for the training of engineers to take charge of estates and of mechanics for the handling and maintenance of farm machinery.

The scheme of rural electrification was originally based upon the belief that the hydro-electric installations, in conjunction with the powerful steam generating stations around Paris and in the Nord, would lay down high-tension feeders throughout the country. From those feeders local companies would supply transformers and put down mains for the distribution of current in their particular districts. The hydro-electric concerns would be required to supply current for rural purposes at a specially low price, while the State would contribute to the expense of laying down the local installations. To a certain extent that plan is already being followed, and some departments are supplied with current from the high-tension feeders passing through them. This is especially the case with the northern departments. Over the greater part of the country, however, such facilities are not likely to be provided for many years to come, and meanwhile encouragement is offered to co-operative societies to lay down their own heat plants. In cases where this has been done with the aid of State subsidies it is claimed that successful results have been obtained. Generally there is no profit in supplying farms with current, but profit is made by a local distribution for lighting purposes. In the debate in the Chamber of Deputies it was recognised that the only satisfactory solution was to distribute current by high-tension feeders, and even under these specially favourable conditions it is by no means certain that the distribution can be effected at low cost. Although agriculture is the staple industry of the country, the consumption of current by it can only be about one-tenth the total consumption in industrial centres, and the cost of feeders and mains would add considerably to the standing charges. It is obvious, therefore, that if electricity is to be supplied at a figure which will justify its use for farm purposes, the State must intervene and take upon itself the burden of reducing the cost to a workable level. If the farmer finds that electricity increases his costs per acre he will dispense with it altogether. He may be able to get more off his land by selecting the most economical time for electrical tillage, but be that as it may he will not burden himself with heavier charges. Consequently, a scheme of general electrification can only be carried out with the aid of the State; that is to say, the taxpayer will have to pay a part of the costs, small though it may be, and it is argued that he will be recouped for his participation by the increased national prosperity due to the smaller purchases that may have to be made abroad. It is estimated that the cost of electrifying the rural districts in France will be about 1200 million francs. Evidently, the country cannot bear that charge, any more than it can provide the fifty million francs which the State is morally engaged to supply this year in the form of subsidies to co-operative agricultural societies and others for the laying down of electrical generating stations all over the country. All that can be allotted to the Minister of Agriculture for that purpose is nine million francs. Hence some arrangement had to be found whereby the societies would be able to raise the capital necessary with the guarantee of the State. The Chamber of Deputies decided that the nine million francs should be employed, not as a direct subsidy, but as a guarantee of interest on capital which will be raised by the departments, communes and societies for the carrying out of rural electrification works. This arrangement should lead to a public subscription of 300 million francs for the purpose. In addition to this possible amount, the Finance Commission proposes the acceptance of an offer from the Caisse des Dépôts et Consignations of loans up to 600 million francs at a low rate of interest and repayable in a period of forty years. Thus the scheme proposed by the Government provides for an expenditure of practically 900 million francs upon electrification works for the benefit of the agricultural industry, representing about three-quarters of the amount necessary to produce the 350,000 kilowatts required by agriculture, in addition to what will be supplied to other consumers as a means of ensuring a more lucrative source of revenue.

The programme may therefore be regarded as having entered upon a stage of practical realisation. A large number of rural districts are already supplied with electricity, and 450 others have applied for State subsidies. The proposal to electrify the agricultural districts has aroused so much enthusiasm that the work will doubtless be carried out with considerable vigour until, within a comparatively short time, it will be an exception for a farm to be run without an electrical equipment. The movement has been rapidly gaining ground, because it is regarded as the only possible solution of the problem of developing agriculture with limited and expensive labour; but the question of cost to the farmer may prove to be one that can only be solved by a much heavier participation of the State.

Electricity Supplies.

THE repeated references which are made to the benefits which would accrue from abundant supplies of electricity in this country indicate that there is a keen desire on the part of those interested

to see those supplies established. Speaking at the British Electrical Developments Association's annual luncheon, on Friday, March 16th, Lord Haldane referred to the Coal Conservation Sub-committee's report, which shows that if the power supply in the United Kingdom were dealt with on comprehensive lines and advantage were taken of the most modern engineering developments, no less than 55 million tons of coal could be saved per annum. The electrification of railways would also be facilitated and many benefits would result from the use of electricity in the home. Few, apart from those interested in gas undertakings, fail to appreciate the merits of electricity; but in order that the public may be induced to use it to the extent which electrical engineers and others desire, something more is needed than the mere prospect of saving the nation's coal. What the public is mainly interested in is the cost per unit, a matter with which the report to which Lord Haldane alluded does not deal. Another interesting speaker was Mr. W. B. Woodhouse, who maintained that power generation is a specialised business, which should be left to power experts, whilst the manufacturers should concentrate all their energies on the particular class of work upon which they are engaged.

There is much to be said for electric driving in factories and the employment of electric current for domestic purposes. The question which seems to be unsettled, however, is whether a scheme such as that portrayed in the Coal Conservation Sub-committee's report would result in a universal reduction in the price of current. The recent discussion in Birmingham on super-power stations showed that there are points in favour of and against the generation of electricity on a large scale. Since that discussion two other meetings have taken place, at which the super-power station question has received attention. In an address before the King's College Engineering Society, Mr. C. H. Wordingham dealt with the development of the public supply of electrical energy in Great Britain, and showed that the large super-power station is not in every case desirable. The Electricity Commissioners, it was pointed out, are not invariably in favour of such stations. Whilst they are undoubtedly impressed with the advantages of plant concentration and the transmission of energy over long distances, they are not by any means tied to the capital station idea, and they are quite open to conviction that other schemes may in certain cases be desirable. In a number of areas there are, of course, parts or individual towns which are so isolated that, even though the cost of local generation is considerably higher than it is in a capital station, it is cheaper to generate on the spot than it is to transmit the cheaply produced energy over long distances. Another matter with which Mr. Wordingham dealt was the load factor. It is perfectly well known that by combining loads of a very different character into one load on a single station the load factor is improved. Much has been made of this fact by advocates of super-power stations, but there is not much doubt that the argument has sometimes been carried too far. As Mr. Wordingham explained, the advantages arising from the superposition of loads from different quarters of a large town are not so marked as when the loads of a number of towns are combined. It was shown, in fact, in a report issued about two years ago that if, in the case of London, all the electrical undertakings were supplied from a single station—which is impracticable—the advantage from the point of view of load factor would be small.

The other recent lecture to which we have alluded was on "Power Production in relation to Ultimate Values," and was delivered by Mr. Hugh Seabrook before the Bradford Engineering Society on February 26th. "The super-power station," Mr. Seabrook said, "is becoming much less popular among engineers than it was a year or two ago. The prospect of enormous power stations containing 50,000-kilowatt sets is at first sight a most attractive one. To-day, however, I think that engineers are settling down to what may be called medium-sized stations (linked up where possible), rather than a few enormous stations giving a 'cheap' and abundant supply of electricity throughout the country." Like many other engineers, Mr. Seabrook is of opinion that huge power stations would not provide consumers with current at lower rates or in many cases at rates equal to those charged by many smaller undertakings. Still, Mr. Seabrook realises, as others who have studied the problem realise, that the large station is sometimes the right type to adopt. Whatever method of generation is employed, it is important to remember that really cheap current is just as essential as the question of saving coal, and that the establishment of capital stations will not necessarily lead to the universal application of electricity. Every endeavour must be made to cut down capital expenditure, and far more attention must be given in the future to the business organisation of supply undertakings.

Obituary.

SIR JAMES DEWAR.

THE scientific world is very much the poorer by the death of Sir James Dewar, which took place early in the morning of Tuesday of this week. Sir James was not, strictly speaking, an engineer, but his life's work marched so nearly hand in hand with engineering that our profession must mourn his loss almost equally with that of the chemist, with which his career was more particularly identified. One is accustomed to associate with the Royal Institution of Great Britain the idea of progress, and Dewar, as occupying the position of Fullerian Professor of Chemistry in that historic building, ably upheld its traditions in that respect. All the world knows of his researches into the phenomena witnessed, and the behaviour of materials, at extremely low temperatures, and it will probably be in connection with his discoveries in that direction that his name will most prominently go down to posterity. His invention of the vacuum flask, now known universally as the Thermos flask, was really incidental to his other discoveries in the domain of cold, but it has proved of very considerable value to the world at large, seeing that by its means hot liquids can be kept hot, and cold liquids cold, almost indefinitely. What he sought to discover and what he did discover was a vessel in which he might store for reasonable periods without serious loss such bodies as liquid air. But he must evidently have realised what a boon his invention must confer on mankind in general, and, seeking not emolument for himself, he proclaimed his discovery to the world. He did not, we believe, make a penny piece out of it. Then, too, his researches made feasible the commercial isolation of gases in a manner impossible before, and revealed many secrets which otherwise would have remained long hidden. Nor must it be forgotten that to him, in collaboration with the late Sir Frederick Abel, is due the discovery of the smokeless "powder" used by the British Army and Navy—cordite.

We make no attempt at giving a life history of this most distinguished Scotsman—he was born in Kincardine-on-Forth in the year 1842—but add our lament to that of scientists the world over that he was not spared for many years longer to carry on the beneficent work which has been of such good service to humanity at large.

The Coal Resources of Borneo.

IN some notes on the coal measures of Sarawak, Borneo, contributed to the South Wales Institute of Engineers, Mr. C. F. J. Galloway says that at Silantek, within twenty miles of the estuary of the Batang Lupar River, coal of good quality has been known to exist for over half a century. An attempt was made by Mr. W. Walters, an English mining engineer, as long ago as in 1873, to draw to this field the attention it deserved. Then, however, as again on a later occasion, this exceptionally promising field was abandoned in favour of other areas close to the sea, where less initial outlay was required, but where the coal was of vastly inferior quality.

If the money which has been lost in Labuan had been put into Silantek, there can be no doubt that, instead of having now an abandoned mine in which many thousands of pounds have been sunk, there would have been one of the finest coalmining concerns in the East.

A typical analysis of an outcrop sample of Silantek coal is the following:—Moisture, 1.93 per cent.; volatile matter, 24.61 per cent.; fixed carbon, 67.61 per cent.; ash, 5.85 per cent.; 100.00 per cent; sulphur, 0.39 per cent.

This is, we believe, better than the best Australian coal on the market—that from the N.S.W. southern area—and is far superior to anything else on the Singapore market, except British steam coal.

The State of Sarawak has in this coalfield an asset of immense possibilities, the extent of which is not yet known. A seam of from 4ft. to 5ft. in thickness has been proved over a distance of three miles on the outcrop, which runs in an east and west direction along the northern base of the Kalingkang Mountains. It may extend for many miles further in either direction. As it dips into the mountains, it is probable that the limit of workable coal will be set by the line at which the thickness of cover becomes too great for economic working. If the dip at the outcrop—10 deg. to 12 deg.—continues, the thickness of cover will reach 1000 yards at a distance of about two miles from the outcrop. Within this limit we have thus six square miles, which, allowing for only 4ft. of coal, gives over eighteen million tons. The persistence and regularity of this seam over a distance of three miles indicates a freedom from disturbance of any consequence in that distance; but, in a country in which igneous intrusions are not uncommon, and in which geological investigation is extremely difficult, it is not advisable to form too definite conclusions without thorough investigation by boring and otherwise.

In view of the fact that the extent of this field beyond the three miles known may be very great in either direction, as well as to the dip, and that other seams of quality similar to the one mentioned are known to exist, some of which will in all probability be found to be workable, the magnitude of the proposition becomes evident.

The fact of its being situated at a distance of twenty miles from navigable water has in the past been the great deterrent to the development of this field. The intervening country is partly swamp, similar to that over which the railway runs at Sadong. But a considerable portion of it is on rising ground, skirting the bases of hills, so that the construction of a railway presents no serious difficulty. A great danger to navigation in the rivers is caused by the large tidal bores to which they are subject for a considerable distance up from the mouth. The proposed position for a wharf on the estuary of the Batang Lupar River, for the shipment of Silantek coal, is below the lower limit of the bore, and would, therefore, be entirely free from that danger.

There is, therefore, no real difficulty in the way of developing this coalfield. A rather larger initial outlay is required than in the case of an area nearer navigable water. But the difference between the quality of this coal and that of any other known in the country would, it is considered, compensate for the greater outlay in the course of a very few years.

REINFORCED CONCRETE ROAD IN FLINTSHIRE.

THE members of the North Wales Branch of the Surveyors' Institution, on the occasion of a meeting recently held at Rhyl, were conducted over the new road which is in course of construction between that town and Gronant, by way of Prestatyn. The road is a continuation of the existing coast road, and it has been carefully laid out so as to avoid the many turns and twists, and heavy gradients of the present sinuous existing road.

Mr. R. G. Whitley, Assoc. M. Inst. C.E., the county surveyor of Flintshire, under whose supervision the entire work is being carried out, and under whose guidance the inspection was made, explained that the total length of road, so far under construction, was about six miles, of which half the length was in reinforced concrete. The estimated cost for the six miles was, he said, £36,000, of which the Ministry of Transport was bearing half the cost. The foundation was extremely bad, as the road had to be taken over spongy marsh land, and he had decided to employ reinforcement. The road had to be raised for 2¼ miles, so as to be above high tide level, and as no other filling material was available, sand had to be used for the purpose. The shoulders of the road have been turved in order to avoid the sand spreading, and a layer of clinkers was laid upon the sand and rolled by a 6-ton tandem steam roller. Upon the bed thus prepared, the reinforcement and concrete was laid. The sand was obtained from the sand hills near Rhyl, and was carried by a line of Decauville track in tipping trucks hauled by a locomotive. Mr. Whitley gave figures showing that, to the date of the inspection, some 37,500 tons of material had been hauled at the low rate of 5d. per ton. The reinforcement, which is of the Walker-Weston pyramidal interlocked double-layer type, was laid, and the concreting done in 13ft. alternate bays sections in the direction of the length of the road. The road is 20ft. wide and 50ft. between fences, with provision for widening, and it has been formed so that the top surface has a cross-fall of 1 in 50, the thickness of the concrete road in the centre being 8½in.

DIESEL-ELECTRIC ENGINES IN TUNIS.

THE Bone-Guelma Railway Company of Tunis possesses a main line of normal continental gauge and subsidiary lines of narrow gauge. These latter run as far south as Gabes, as well as serving a number of branches on the company's system.

In order to improve the local service of this railway the Administration of Public Works has elected to commence by introducing auxiliary trains propelled by electric motors worked by internal combustion engines. Should results warrant—and there appears to be little doubt to the contrary—there will be ample scope for extension throughout the whole of the company's narrow gauge districts and eventually to the main lines. At the present time the idea has materialised in the way of a small experiment to augment the traffic between Tunis and Hamman-el-Lif, a run of about twelve miles without gradients worth mentioning.

Trial runs of a Diesel-electric locomotive took place during the latter days of February and, being considered satisfactory, a train was added to the regular timetable on March 1st. The firm that secured this preliminary order is Swedish, the engine being a 120 brake horse-power Polar. Being used on the same routes as steam locomotives, it is necessary to ensure a speed as great as that already obtained by them, and it is also essential that the smallest trains shall have a capacity of at least 100 passengers. The engine runs on mazout—crude oil—and the consumption of fuel is estimated at 500 grammes per kilometre run, which represents a very important saving in comparison with the steam engines, which burn at least 6 to 7 kilos. of briquettes per kilometre. The *personnel*, moreover, is reduced by the elimination of the stoker. The capacity on the level is stated to be 60 kiloms. per hour with a load of 40 tons, the load in question being counted as five small coaches with 130 seats.

Should the results be favourable, it is the intention of the Administration to order a second locomotive, of at least 210 to 250 brake horse-power, in order to continue the experiments. The reason given for placing the order abroad is that the Administration was faced with the difficulty, both technical and financial, arising from the fact that no French constructor could furnish sufficient proof of satisfactory performance of this type of traction. Under these conditions it would appear that the future field is more or less open to all serious competitors who can furnish the guarantees and references necessary to inspire confidence.

The Design and War Service of Coastal Motor Boats ("C.M.B.") : *

By Sir J. E. THORNYCROFT, K.B.E., and Lieut. BREMNER, R.N., D.S.O.

WITH the great increase in size of all torpedo-carrying vessels in the years preceding the war, it seemed that anything in the nature of the early small torpedo boats were things of the past, but the war had not been long in progress before the idea of employing quite small motor torpedo boats was put forward, and during its course over 100 were built.

In the early summer of 1915, three officers, Lieutenants Hampden, Bremner and Anson, suggested the possibility of utilising quite small motor boats to go over the mine-fields and attack the German bases. After the suggestion had been tentatively approved it was decided that, to give any possibility of success, the boats complete with an 18in. torpedo should not exceed the weight of the ordinary 30ft. motor boats carried in the davits of the light cruisers. The limit of the weight had to be under 4¼ tons, of which the torpedo alone was about ¾ ton. The successful design referred to had a form which was rather beamy with a single step formed by the fore body, which in itself took the form of a normal bow, but built with a sharp angle of chine running from the step to the stem. This sharp angle gives a lift not only in a fore and aft direction, but in a lateral one as well, and by keeping a distinct rise of floor at all the sections back to the step a form is produced which does not slam unduly in rough water. Boats with hulls of this form can be made to skim satisfactorily when weighing as much as 45 lb. per horse-power. After considering different dimensions it was concluded that it would be necessary to have a boat of 40ft. in length to carry the torpedo and fulfil the other requirements—Fig. 1—and Fig. 2.

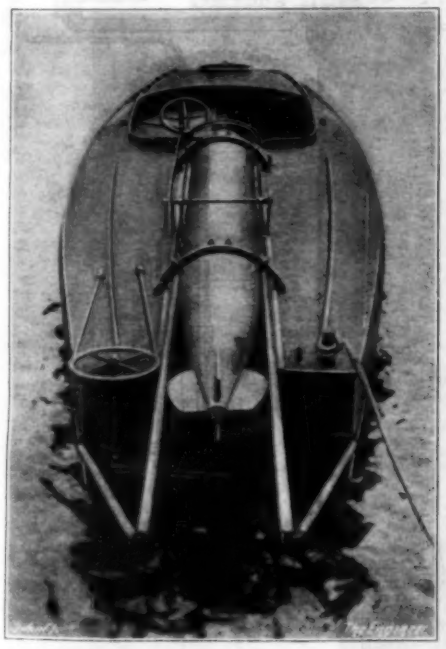


FIG. 2—STERN VIEW, SHOWING TORPEDO

While the condition was laid down that the total weight of boat and load should be less than 4¼ tons, in order to use the existing davits, there was the quite independent limit of weight within which the boat must be kept in order to give the speed performance of over 30 knots. The weight of the machinery which could be obtained for the power required, estimated at 250 horse-power, was known, and the difference between this and 4¼ tons was available for the hull and torpedo gear, &c. It was obvious that no ordinary form of torpedo discharge gear could be used, as no margin of weight was available, and that the arrangements for carrying the torpedo must be incorporated in the structural hull of the boat itself.

It was decided that, to be effective, the boat must be able to fire its torpedo while travelling at full speed. Any system of discharge over the bow was looked upon as unsatisfactory, not only from the point of view of good results from the torpedo but also from the difficulty of carrying a torpedo in the fore part of the boat. It was decided to build the after body of the boat to form a trough, with rails on which the torpedo would be carried on its side lugs, and to extend these rails beyond the stern of the boat so that the torpedo would drop clear when discharged. The obvious objection to carrying the torpedo in the stern, necessitating turning the boat away when attacking to bring the torpedo in the right direction to fire, would necessarily greatly reduce the chances of a successful attack and expose the boat to much greater risk of being hit by the enemy. It was, however, thought possible that, with the boat travelling at over 30 knots speed, which would be approximately the same as that of the torpedo, it might be possible to discharge the torpedo from the stern of the boat tail instead of head first. Preliminary experiments were made, and the torpedo experts of the Vernon reported that they anticipated the results would be successful and, in view of this report, the Director of Naval Construction, Admiral Sir Henry Jackson, who was the First Sea Lord at the time, gave the order for twelve boats to be built.

Experience with high-speed racing boats had shown that it was not possible to make nearly so light a hull that would stand in steel as in wood, and also that the timber construction must be elastic, it having been found that any knees of sawn timbers were invariably broken or pulled away from other parts of the structure, and that good results could only be obtained by using timbers of American elm, which would easily bend, and two or more skins of light planking. It will be noted that the construction which was adopted is almost identical with that which has since been carried out on a lighter scale, in the most successful seaplanes. From previous experiments, the builders were satisfied that the best form had been adopted, but model experiments and trials of actual boats of alternative forms were tried, see curves reproduced in Fig. 3. The average speed of the first 40-footers, which was considerably improved upon in the later boats, was 33.5 knots, with 250 horse-power, the screws having a pitch of 36in., and a diameter of 22.5in., the displacement, with full load of fuel, crew, torpedo, and sea-going gear, being 4.25 tons. With a skimming boat it is not easy to say exactly what the resistance is, and, therefore, to claim a very high efficiency of the propeller, but there could be no doubt that it was very good. Besides the ordinary design a special form was used on some of the boats, which is illustrated in Fig. 4. The reason for adopting this form was the facility it gave to pass over obstructions, such as wires or booms. It will be seen that it is not unlike some of the earliest screw propellers ever tried, and it is very remarkable that the efficiency was almost as good as the best propeller of normal type that could be designed.

After the 40ft. boats had been proved a success a large number of 55ft. boats of about double displacement, fitted with twin engines and carrying two torpedoes, or a torpedo and depth charges, were built. The first few of these were fitted with two 250 horse-power engines, but latterly with engines of increased power. With two motors of 375 horse-power each a speed of 40 knots, with a full load, on a two hours' trial was obtained. Boats recently delivered to the French Government made the run from the Thames at Westminster to Cherbourg in a running time of 7 hours 56 min., breaking the run at Portsmouth to pick up fuel. The distance of the run being 270 miles, the speed works out at 34 knots.

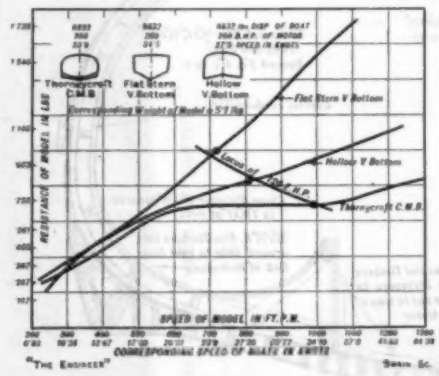


FIG. 3—MODEL TESTS AND ACTUAL SPEEDS

The sheer draught and midship section—Figs. 5 and 6—show the details of the scantlings and the construction of the trough for the torpedoes, and how they were arranged to give the necessary strength to the hull. The fact of the trough cutting through the deck of all the after part of the boat made it necessary to tie the boat together in some other way. This was done by making the supports of the trough in a vertical plane act as cantilever girders to hold the deck and the top of the trough in position. It will be seen that the construction of the trough, including the rails for the torpedoes, was of wood, with the exception of the attachment for the ram impulse gear and the release gear, which was incorporated in the lifting attachment, and the wooden supporting rails were faced with bronze. To discharge the torpedo satisfactorily, it was found that a velocity of 25ft. per second, about 17 knots, was sufficient, and assuming the boat was travelling at 30 knots, the torpedo would enter the water with the tail slightly down at a forward velocity of 13 knots. The impulse to push the torpedo out was given by a long-stroke ram, fitted with an aluminium cap, or "bell-head," as it was named, which was long enough to cover the firing pistol and bore of the torpedo head where the spherical end was near the full diameter—Fig. 7. While at first it was doubted if the head would be stiff enough to take the thrust without buckling, it was found that by making the surface in contact about 3in. wide, no deformation occurred. The bell-head was fitted with openings so that access was given to the firing pistol to withdraw the safety-pin. It was at first thought that it would be best to operate the ram by compressed air, but it was found that the reservoirs would be too heavy, and so it was arranged to make the supply of high-pressure gas to operate it by burning cordite in an enclosed vessel at the moment the torpedo was to be fired; 1500 gr. of No. 37 cordite were found to be sufficient, giving a pressure of about 4 tons in the explosion vessel, which was reduced, by taking the gases through a small orifice, to about 1000 lb. pressure in the ram. The diagram shows the construction of the cartridge container and explosion vessel. To avoid all

FIG. 4—SPIRAL PROPELLER FOR WIRE JUMPING

* Institution of Naval Architects—Abstract.

possibility of firing prematurely the pistol was not cocked before the moment of firing, the striker being operated by a pull through a wedge ; the officer in charge of the boat, having the firing lever alongside the steering wheel, by the one motion withdrew the side stops which were in the form of bolts passing through supporting rails and deck against the after side lugs, and then operated the firing pistol.

It has already been explained that the supporting rails were extended beyond the stern of the boat and, to avoid the possibility of the head of the torpedo or pistol striking the end of the trough or stern of the boat, the head of the torpedo was supported in a loose stirrup until it was clear of the rails, the stirrup, as soon as the torpedo was in the water, falling clear. The running of the torpedoes fired in this way was most satisfactory, the depth keeping being is proportionately greater. The crews of the smaller boats consisted of two officers and one motor mechanic, and of the larger boats two officers, two motor mechanics and, in some cases, one wireless operator. The motors of the boats built during the war were not very effectively silenced, but those which have been built since have quite an efficient silencer. The unsilenced exhaust was so similar to that of the aeroplane motors that the C.M.B.'s were mistaken for them, and so the noise was not so detrimental as at first had been anticipated.

The first success was obtained with boats operating from Dunkirk early in 1917, when four of them, under the command of Lieutenant Beckett, attacked German destroyers off Ostend, sinking one and scoring several other hits. Largely as a result of this successful operation, more boats were ordered, including twin-screw with flares to indicate the right turning points for the blocking ships. Two of them entered the harbour in the early stage of the operation to torpedo a vessel alongside the Mole, whilst others were fitted with Stokes trench mortars to throw bombs over the Mole on to the aeroplane sheds.

In the second action at Ostend, when the Vindictive was successfully placed in position, two C.M.B.'s were specially told off to torpedo the ends of the piers to put the guns on them out of action. While others made a smoke screen, one of them went in ahead of the Vindictive firing Verey lights to indicate the exact position of the entrance.

Admiral Sir Roger Keyes, in his official report of the blocking action, referred to the highly efficient handling of the boats by Lieutenant Welman, the officer in charge of them from the Dover base. It is remarkable that,

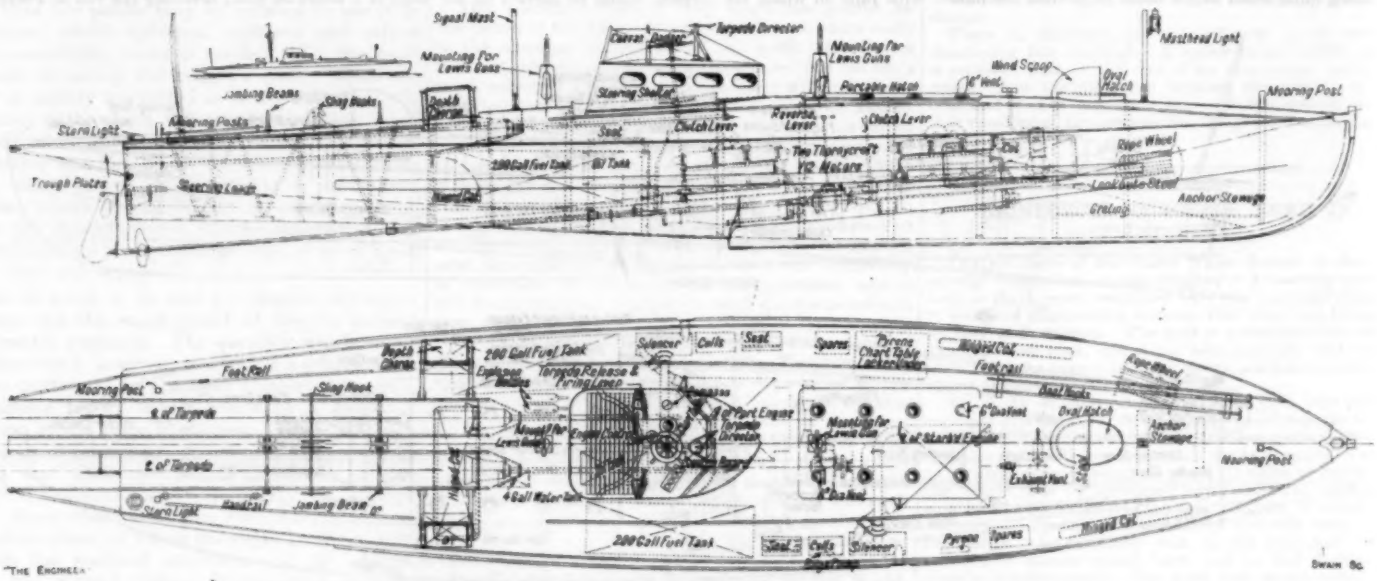


FIG. 5—SIDE ELEVATION AND PLAN OF 55-FOOT BOAT

found generally better than any other method of discharge. For travelling in the seaway, jambing screws were arranged to hold the torpedo tightly down on to the rails. Access was arranged through the bottom of the trough where necessary to get at the underside of the torpedo in case it had to remain in the trough for a long period, and for use in the winter arrangements were made to keep it warm by a connection from the exhaust of the engine. In the 55ft. boats carrying two torpedoes the arrangements were the same, but in duplicate.

Propelling Machinery.—To provide the 250 horse-power which was necessary, a weight of only 2100 lb. was available, and meant the employment of motors which were very little heavier per horse-power than those for aeroplane use, but for work at sea there are many conditions which make a motor of the pure aeroplane type unsuitable.

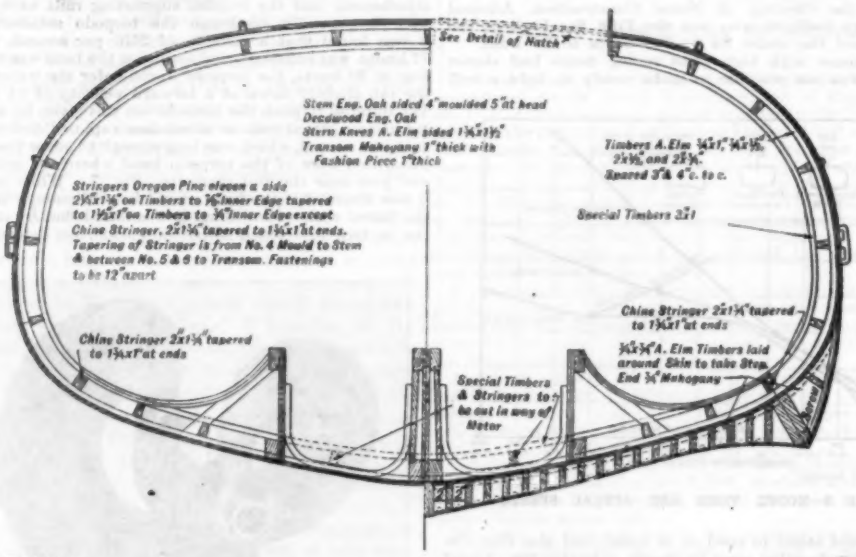

See Detail of Hatch
Stem Eng. Oak sided 4" moulded 5" at head
Deadwood Eng. Oak
Stern Knees A. Elm sided 1¾"x1½"
Transom Mahogany 1" thick with Fashion Piece 1" thick
Timbers A. Elm ¾"x1", ¾"x½", 2"x½" and 2½"x¾" Spaced 3" & 4" c. to c.
Stringers Oregon Pine eleven a side 2½"x1½" on Timbers to ⅜" Inner Edge tapered to 1½"x1" on Timbers to ¾" Inner Edge except Chine Stringer, 2"x1¾" tapered to 1½"x1" at ends. Tapering of Stringer is from No. 4 Mould to Stem & between No. 5 & 6 to Transom. Fastenings to be 12" apart
Special Timbers 2"x1"
Chine Stringer 2"x1¾" tapered to 1½"x1" at ends
Chine Stringer 2"x1¾" tapered to 1½"x1" at ends
¾"x¾" A. Elm Timbers laid around Skin to take Step. End ¾" Mahogany
Special Timbers & Stringers to be cut in way of Motor
"THE ENGINEER"
SWAN Sc.

FIG. 6—MIDSHIP SECTION OF 55-FOOT BOAT

During the rush to provide boats quickly a certain number of motors designed for aeroplanes were used, but those which have proved really successful were designed specially for these boats, the 250 horse-power 12-cylinder V-pattern engines having cylinders of 5¼in. by 7in. They developed their power at 1400 revolutions. The motors built for later boats were also V-pattern 12-cylinder engines, having cylinders of 5¾in. by 7in., which developed about 375 horse-power at 1600 revolutions, and weighed 2600 lb. The first boats were not fitted with reversing gear, but the later twin-screw boats were so fitted on one engine, for manœuvring. The fuel capacity of the 40ft. boats was 100 gallons, which gave a radius of 160 miles, and the 55-footers carried 350 gallons, which gave 200 miles, the difference in radius at full or reduced speed being not very great, as the resistance at a slow speed when the boats are not skimming

55ft. boats, an experimental one having already been built. Captain Walwyn, of the Anti-Submarine Department, suggested the employment of these 55ft. boats, carrying a single torpedo and four depth charges, for anti-submarine work, and a great deal of patrol work was eventually done, from all the bases, with these 55-footers. Owing to their larger dimensions they were, of course, better sea boats than the 40-footers, and in the Channel and on the Belgian coast largely replaced them. The boats patrolled the Belgian coast inside the sands, and were able to keep a constant watch on Ostend and Zeebrugge. On one occasion, when five German destroyers attempted to dash through the Straits, C.M.B.'s met them on the return and succeeded in torpedoing one of them.

Mine-laying.—Owing to their shallow draught and high speed they were able to lay mines in positions which were impossible for other craft, and very useful work was done by them on the Belgian coast. The special mines which had been designed for laying from submarines were carried on trolleys supported on the rails in the torpedo troughs, and towards the end of the war a number of 70ft. boats were built to carry four of the largest type of mines.

The blocking actions at Zeebrugge and Ostend have been fully described as far as the work of the larger vessels was concerned. Official reports made reference to the good work done by the C.M.B.'s, but it may not be out of place to refer in more detail to the part they played. In the Zeebrugge action the C.M.B.'s were not only responsible for the smoke screen, which they made by the employment of chlor-sulphonic acid in their exhaust—this operation being necessarily carried out ahead of the blocking vessels—but they also marked certain positions with one exception, all the C.M.B.'s which took part in the blocking action succeeded in getting away, although they were in many cases very battered and war-worn, with numerous officers and men wounded.

An interesting illustration of the strength of the boats' hulls occurred in the Ostend attack. A torpedo fired from one of them apparently struck something and exploded close under the stern of the boat, and she was actually lifted by the explosion a good many feet. The after-part of the hull was permanently deformed some inches, but

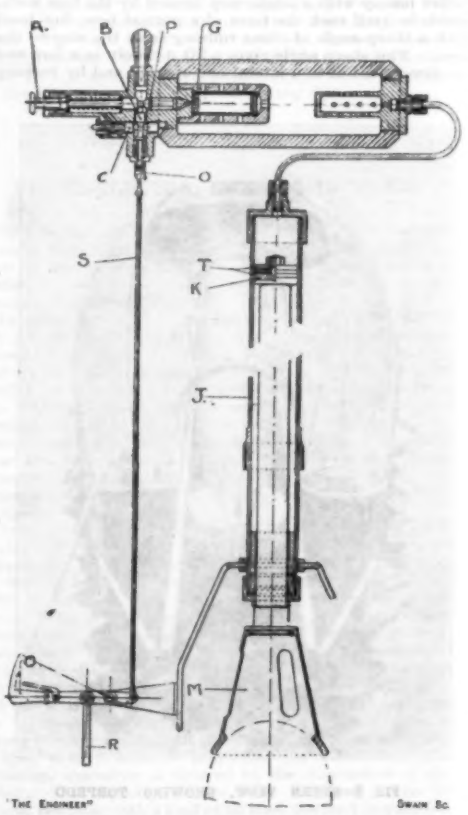


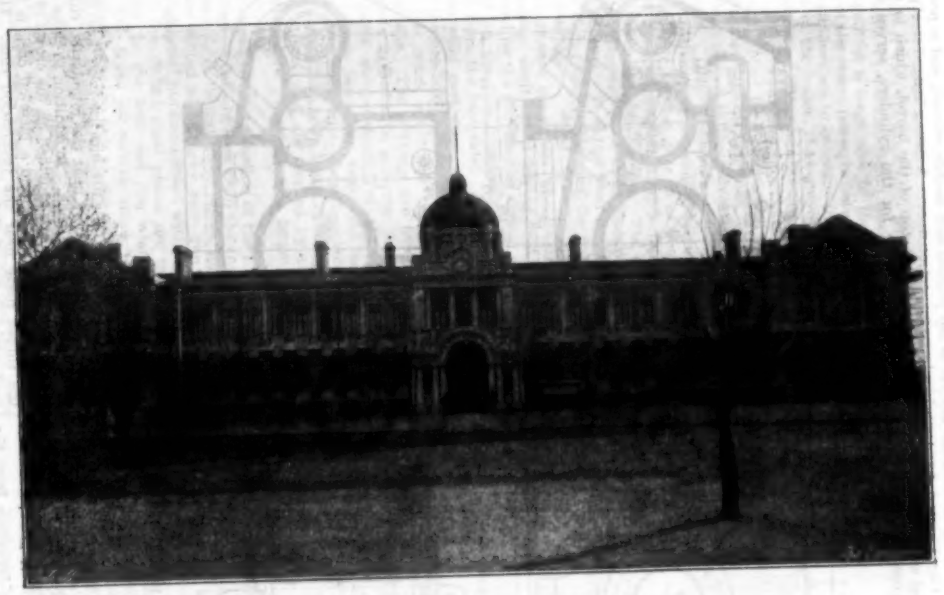
FIG. 7—DIAGRAM OF EXPLOSION VESSEL AND RAM

was in no way fractured ; but a good many of the pipe connections, including the circulating water inlets, were broken, and the crew naturally had a severe shaking. They were nevertheless able to run their boat out of action and to pick up another vessel, which towed them back to Dover. It would seem possible that the fact of the hull being so little in the water contributed to its immunity from damage, but it certainly seems remarkable that the boat should have survived.

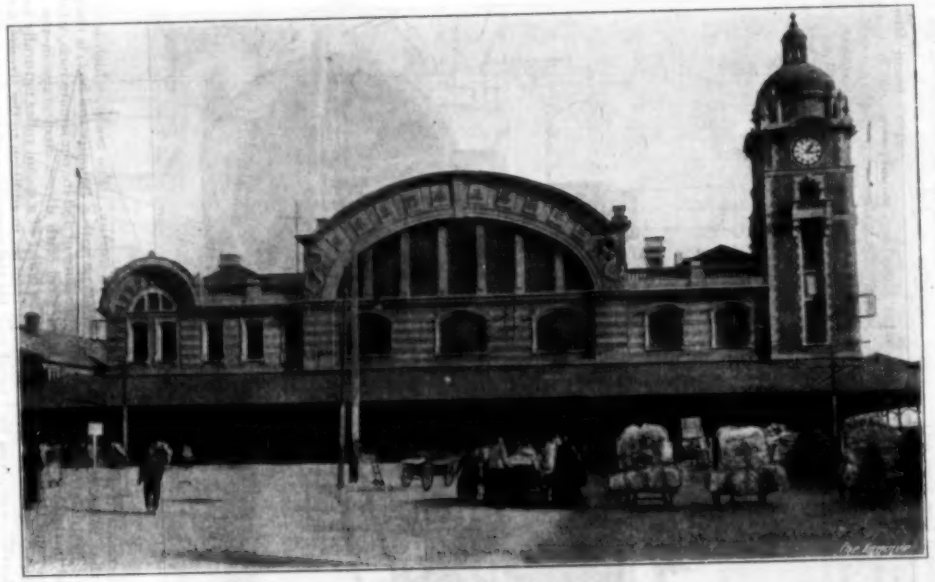
It has been already stated that the original proposal to

THE PEKING-MUKDEN RAILWAY

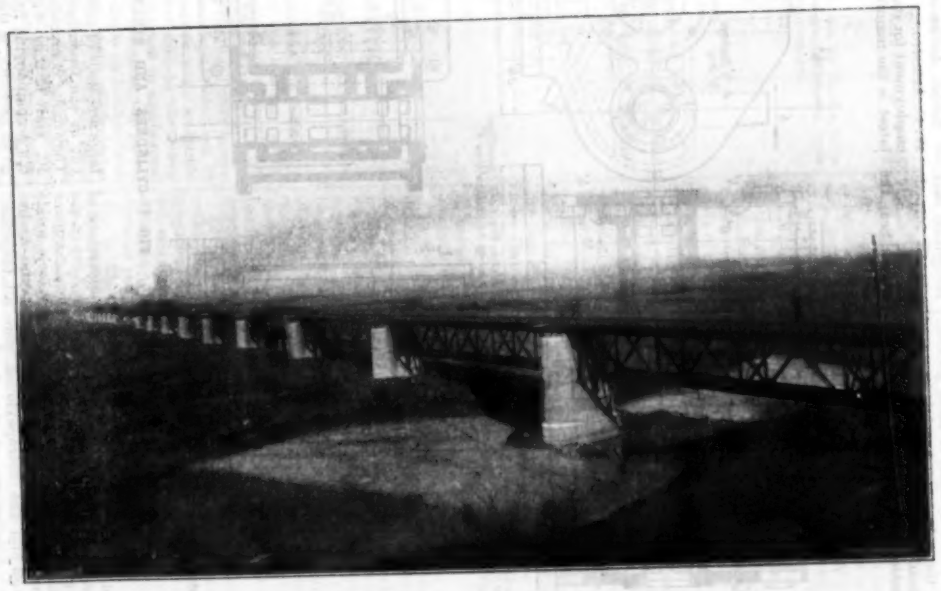
(*For description see page 333*)



THE HEAD OFFICE AT TIENTSIN



PEKING STATION

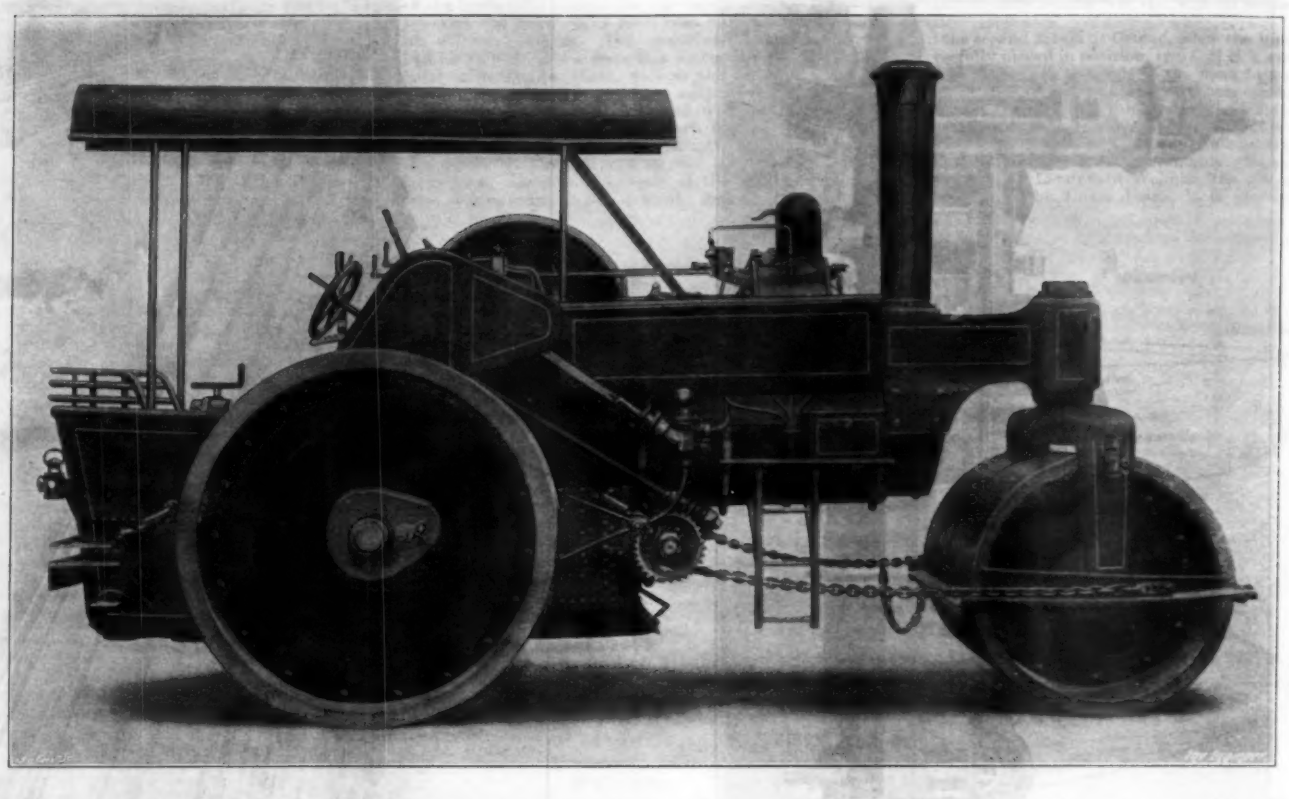


CHU LIU HO BRIDGE

TIENTSIN EAST STATION GOODS YARD

10-TON STEAM ROAD ROLLER

SIR W. G. ARMSTRONG, WHITWORTH AND CO., LIMITED, OPENSHAW, MANCHESTER, ENGINEERS



attack the German bases was not carried out, but numerous reconnaissances were made by the 40-footers carried by the light cruisers, and it was proved that they could be hoisted out and under way very quickly. Beyond some successful attacks on auxiliary craft there is nothing to record. One interesting action between them and some German aeroplanes took place. (Two photographs from one of the aeroplanes showing the action came into British hands, and were given in the paper, but are not reproduced.) In this particular instance the aeroplanes undoubtedly came off best, and many of the crews being wounded and some of the boats sunk, it was not possible for the boats to get away, and having drifted into Dutch territorial waters they were eventually interned; but it must not be forgotten that this action between C.M.B.'s and aircraft was in broad daylight, it being generally recognised that, unless there is some special reason, the small torpedo boat should always attack at night.

Operations were carried out on the Caspian Sea, the Archangel front and in the Baltic, the most interesting of which was the successful attack by Lieutenant Agar on the Oleg, the guardship outside Kronstadt and the subsequent action when an attack was made on the vessels inside Kronstadt Harbour, and the Pamiat Azov, the Andrei Pervozvanni and the Petropavlovsk were all torpedoed and sunk. Limitations of space make it impossible to describe these operations in the present paper.

The authors' endeavour has been to give some account of the revival of the employment of the small torpedo boat in the British Navy, but they feel that some reference should be made to the boats of similar dimensions of slower speeds which were built and employed in the Adriatic by the Italian navy. An account of them, and the principal success achieved by Commander Rizzo when he torpedoed and sunk the battleship St. Itzvan, was given by Captain De Villarey in a lecture at the United Service Institution in 1919.

A New Steam Roller.

AMONG the several directions in which the firm of Sir W. G. Armstrong, Whitworth and Co., Limited, has found employment for its greatly extended workshops, one of the latest is the manufacture of steam road rollers, and quite a large number—of three different sizes—is now being turned out at the Openshaw works of the firm in Manchester. They have compound engines, and are nominally of 8, 10, and 12-tons weight respectively. That shown in the accompanying half-tone engraving, and the drawings given herewith, is the ten-ton size.

It will be noticed that little or no departure from the familiar general outline of steam rollers has been attempted, they embody, however, one or two departures in detail which are noteworthy. The boiler, which is of the usual locomotive type with a Belpaire fire-box, is designed for a working pressure of 180 lb. per square inch, while the fire-box is of steel with direct steel stays in the sides and crown. The boiler of a steam roller naturally has a heavy duty to perform as, in addition to the stresses set up in the usual way by the generation of steam, it has to transmit all forces produced between the front and hind rollers, and also between the cylinders and the crank shaft. For this reason special attention has been given to the joint of the barrel to the fire-box throat plate which is double riveted, as are also the sides and top seams of the crown plate of the fire-box shell. The boiler barrel is formed of one ring 2ft. diameter inside, and carried forward beyond the front tube plate to form the body of the smoke-box. It is lap jointed and double riveted, and is provided with a large inspection door. A strong flanged steel plate saddle is riveted to the top of the barrel, which in addition to forming a seating for the cylinders, serves as a steam reservoir or dome. The fire-box has mud holes and doors at the two front corners near the foundation ring, and a wash out plug at the back. In addition to these openings two wash-out plugs are provided on the crown of the fire-box, at front and back, and a blow-off cock is fitted on the throat plate near the foundation ring. The boiler feed water is supplied by a short stroke pump and an injector of the Penberthy type, both of which deliver into a common clack box fixed on the fire-box top. Two

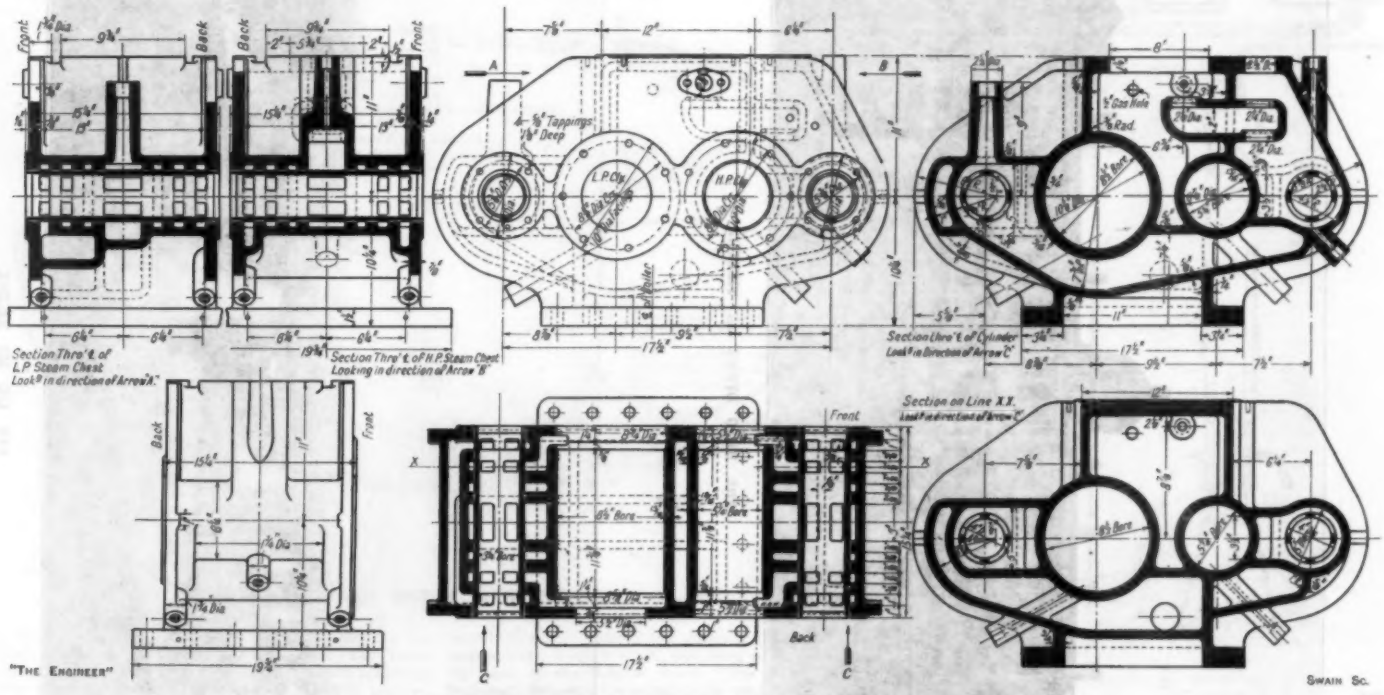

Front
Back
Back
Front
Section Thro't. of L.P. Steam Chest Looking in direction of Arrow "A"
Section Thro't. of H.P. Steam Chest Looking in direction of Arrow "B"
4—⅝" Tappings ⅞" Deep
L.P. Cyl.
H.P. Cyl.
Section Thro't. of Cylinder Looking in Direction of Arrow "C"
Section on Line X.X. Looking in direction of Arrow "D"
Front
Back
"THE ENGINEER"
SWAIN SC.

FIG. 1—CYLINDERS AND STEAM CHESTS OF 10-TON STEAM ROAD ROLLER

sets of water gauge glasses and cocks are attached to the back of the fire-box. A steam cock stand fixed on top of the fire-box supplies steam to the injector, the water lifter, and the pressure gauge cocks. The boiler barrel and fire-box top are covered by an asbestos blanket, and lagged with steel sheets supported on crinoline hoops and bound with brass straps.

The engine is of the two-cylinder compound type with piston valves having internal or central admission. Both cylinders and steam chests are fitted with renewable liners. The cylinder casting—of which we give drawings in Fig. 1—is of the monoblock type, and so designed that under review made of cast steel. The cast iron smoke-box saddle head carrying the front roller fork is of box section and designed to form the base of the chimney and also a tool box, for which latter purpose it is fitted with a hinged lid.

The tank and bunker is built up of steel plates flanged and riveted together and bolted to the fire-box side sheets which are extended backwards for the purpose. The back plate of the tank is stayed on the inside and is fitted with a draw bar and pin, whilst the right hand side plate is reinforced with stiffening plates for the attachment of a road scarifier of standard pattern.

through a single wheel and pinion to the shaft of one of the main turbines, itself geared to the propeller shaft.

Since 1918 there have been about 207 British-built vessels fitted with double reduction, and during the same period twenty-six with single reduction. Unfortunately the excellent record established by the earlier gears has not been maintained. Commencing in December, 1921, there followed throughout last year repeated instances of failure of newly installed gearing owing to the fracture of pinion teeth. There has been a general tendency to associate these failures specially with double reduction, but in reality the percentage of failures is no more in

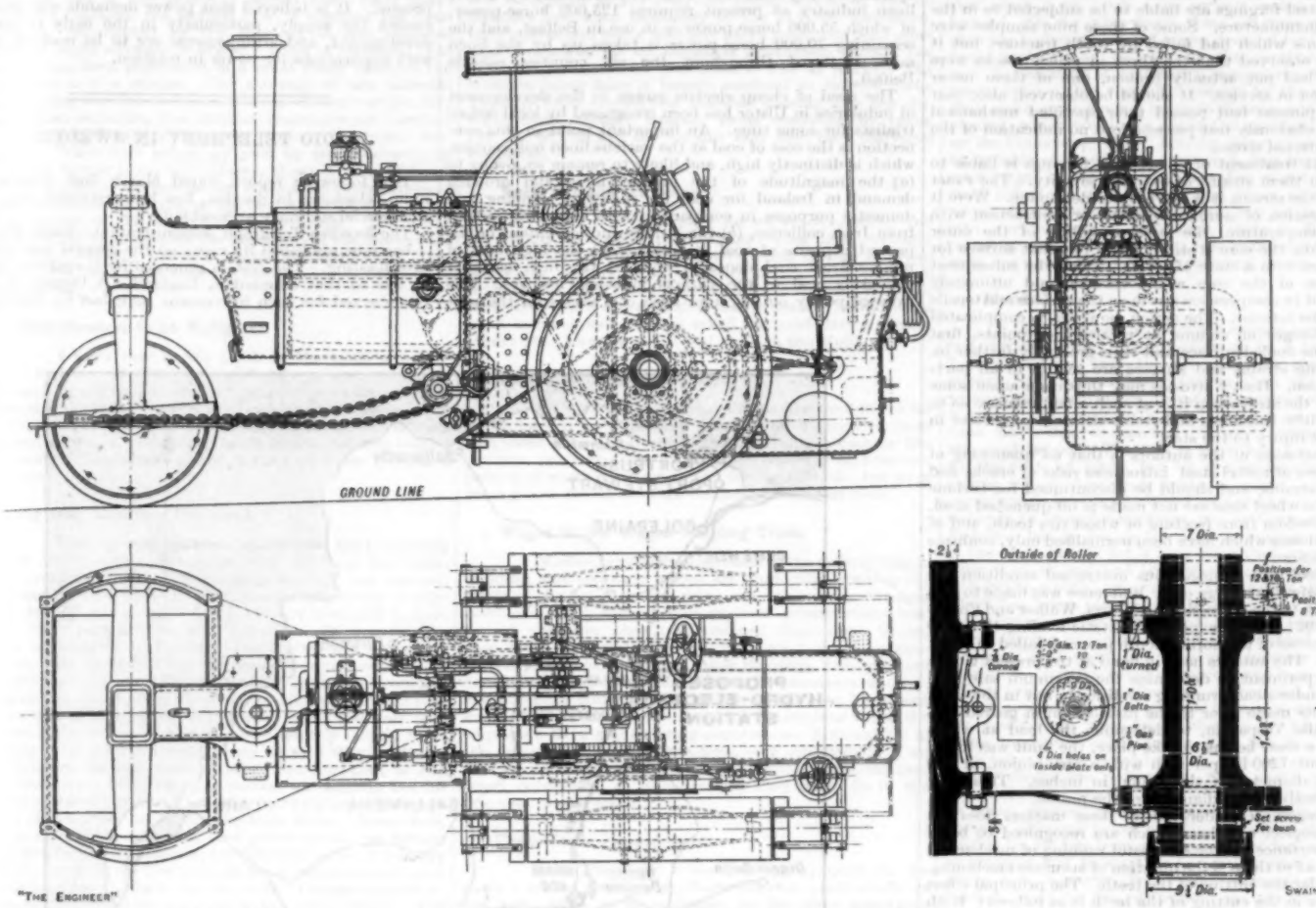


FIG. 2—ARMSTRONG, WHITWORTH 10-TON STEAM ROAD ROLLER

in combination with the steel plate saddle seating on the boiler it forms a capacious steam reservoir or dome. By this arrangement a large area of the cylinder walls and also those of the steam passages between the high and low-pressure cylinders are in constant direct contact with the live steam in the boiler, thus preventing any great drop in temperature of the steam in the cylinders when compounding. The cylinders are provided with forced lubrication supplied by a mechanical lubricator which is driven from the valve motion links.

The pistons as well as the valves are fitted with Ramsbottom rings. The crossheads are of cast steel with cast iron renewable slippers working in circular guides of cast iron. The valve motion gear is of the Stephenson link type with the reversing shaft underhung from brackets attached to the crosshead slides. The connecting rod is of the marine type, with a solid bush of hard gun metal for the small end. The steel used for the valve gear and rods is of high grade to allow of the parts being made as light as possible.

A train of cast steel gear wheel transmits the power from the crank shaft to the driving axle. Two gear ratios are obtained by the provision of sliding gears on the crank shaft and on the first countershaft, which are operated by levers from the footplate. All the gears are machine cut. Two solid cast steel brackets, bolted to the side plates of the fire-box, are used to carry the gun metal bearings for the crank shaft and the two intermediate or counter shafts. The bearings are fitted to the brackets with spigots in order to preserve the alignment of the several parts independently of the bolt fixing. The driving axle is carried in two solid cast steel brackets bushed with gun metal. These brackets also are turned to fit accurately into holes bored in the fire-box side plates to receive them, and are secured by turned bolts. All the bearings are provided with large oil-boxes having syphon feeds.

Fig. 2 shows the construction of the front roller. Each roller wheel—as will be seen from the engravings—is built up of two solid dished steel plates forming the centre which are bolted to a heavy cast iron hub and rim by turned bolts and nuts and fitted with lock washers. The edges of the dished steel plates are machined, and fit accurately on the hub and rim which are respectively turned and bored to receive them. The load is thus transmitted from the hub to the rim directly through the plates and independently of the bolt fixing. The hub bearings are fitted with grease cups with screw-down caps. These wheels have been designed to eliminate the trouble of loose and broken spokes sometimes experienced with the older type of wheel. It will be readily appreciated that the dished wheel besides being strong and rigid gives a better and more uniform distribution of the load on the rim. The fork carrying the front pair of roller wheels usually made in cast iron is in the case of the machine

The following are the leading particulars of the 10-ton (nominal) compound steam roller, viz. :—

Roller wheels—	
Driving	5ft. 3in. dia. by 1ft. 4in. wide
Front	3ft. 9in. dia. by 2ft. 1in. wide
Wheel base	11ft. 0½in. centre
Width rolled	6ft. 6½in.
Length overall	18ft. 6½in.
Width overall	6ft. 6½in.
Cylinders—	
High-pressure	4½in. dia.
Low-pressure	7½in. dia.
Stroke	10in.
Working pressure	180 lb. per sq. in.
Boiler barrel	2ft. dia. inside by 3ft. 9½in. long
Fire-box	3ft. 4½in. long by 2ft. 2½in. wide outside
Heating surface—	
30 tubes, 1¾in. ext. dia.	55.4 sq. ft.
Fire-box	27.1 sq. ft.
Total	82.5 sq. ft.
Grate area	4.56 sq. ft.
Tender capacity—	
Water	115 gallons
Coal	5 cwt.
Weight in working order	13 tons

Mechanical Gearing.*

By the Hon. Sir CHARLES A. PARSONS, STANLEY S. COOK, and H. M. DUNCAN.

THE progress of the marine steam turbine has, as a result of the rapid developments of the last ten years, become identified with that of the means of transmission of power to the slow-moving propeller. Of the total output in British-built vessels, about 10,000,000 horse-power has been transmitted with a single reduction in speed, and about 1,000,000 horse-power with a double reduction. The record of geared turbines in the Navy during the war has shown that confidence in mechanical gearing was not misplaced. In some instances the power successfully transmitted through a single pinion has been as high as 20,000 horse-power, with tooth pressures as high as 1100 lb. per inch of surface. The gears for naval work have been almost exclusively single reduction, usually consisting of two pinions engaging with a common wheel on the propeller shaft. Where, however, geared cruising turbines have been fitted, the power of the cruising turbine has frequently been transmitted by double reduction, the cruising turbine being connected

* Institution of Naval Architects, March, 1923. Abridged.

double than in single reduction in mercantile work during the same period. Out of two hundred and seven vessels with double reduction there have been sixteen such cases of failure, and in single reduction four cases out of twenty-six. So that whilst it may be recognised that the effect of inaccuracies in the teeth is likely to be greater in double reduction on account of the greater energy of the high-speed turbines, this cannot, in face of the facts, be accepted as the explanation of these failures. The design of the single-reduction gears, too, must be acquitted when we take into account the mass of successful naval work with gears of similar type.

When the report came of the second of these failures by fracture, the authors and their colleagues immediately took up with the steel makers the question of the quality of the steel. Investigation of the physical characteristics and both macroscopical and microscopical examination of nickel steel pinions which had failed in this way showed considerable variation in grain size and in physical properties, but did not supply a sufficient explanation for these failures. In almost all cases the fractures were what are termed creeping fractures, consisting of a fine-grained area and a smaller coarse-grained area where the teeth finally broke away. Recent experiments by Dr. Hatfield have shown that such fractures can be produced by repeated stresses in one direction and well above the elastic limit.

In the very early experiments which led to the introduction of mechanical gearing, after the original gearing of the Vespasian had been well tried out, the original pinion was replaced by one of high tensile steel, with the result that several of the pinion teeth fractured on the first voyage. From this experience it was concluded that as a necessary requirement the steel must possess a high degree of ductility. As confidence grew, however, this rule has not been rigorously observed. The tendency has been to use harder steel, nickel steel, or chrome-nickel steel, hardened by oil quenching, and it is with such steels that practically all the fractures have occurred.

Investigations have been made by the authors and their colleagues into the possibilities of producing cracks in oil-quenched nickel steel by heat treatment, such as might be employed in the ordinary process of manufacture. Nine samples experimented upon were all portions of turbine reduction gear pinions of cylindrical shape from 8in. to 12in. diameter, and from 8in. to 10in. long. The material in all cases was nickel steel to the usual specification, viz., carbon 0.25 to 0.32, nickel about 3½ per cent.

The heat treatment in these experiments consisted in heating the sample to a high temperature in a gas-fired furnace, and either quenching it in oil or allowing it to cool out in the atmosphere on a steel plate on the shop floor; the procedure generally followed was to subject the samples to a series of such treatments alternately, quenching from 850 deg. Cent., reheating to 600 deg. Cent. for tempering,

and cooling in air. The initial temperature of the furnace on the insertion of the sample was varied, and in some instances the sample was enclosed in a muffle.

Temperatures were observed by two pyrometers, one of the ordinary thermo-couple type in which the couple was inserted in the furnace and therefore gave the temperature of the furnace itself. The other a radiation pyrometer which was focussed on the sample or enclosing muffle and therefore indicated the temperature of the latter. The accuracy of these instruments was verified during and after concluding the series of experiments.

Cracks have been produced in three samples out of nine submitted to experiment by such heat treatment as nickel steel forgings are liable to be subjected to in the course of manufacture. Some of these nine samples were from pinions which had failed by tooth fracture, but it should be observed that the three in which cracks were produced had not actually broken, one of them never having been in service. It should be observed, also, that all these pinions had passed their specified mechanical tests, but obviously test pieces afford no indication of the state of internal stress.

The heat treatment of nickel steel forgings is liable to produce in them strains of extreme severity. The exact nature of the strains it is not easy to determine. Were it only a question of simple expansion or contraction with varying temperature, the sudden cooling of the outer surface while the core is still hot will put that surface for the moment into a state of tension which the subsequent contraction of the core would reverse, and ultimately there would be compression strain on the surface and tensile strain in the interior. The action, however, is complicated by the changes of volume at recalescence points, first beneath the cooled surface and then gradually farther in, and varying strains and stresses are set up in all parts of the pinion. Heavy stresses may thus come upon some portion of the steel when it is at such a temperature as to be in a brittle condition and result either in a crack or in permanent injury to the steel.

The conclusion of the authors is that oil quenching of large masses of nickel steel introduces risks of cracks and excessive strains, and should be discontinued for turbine gears. The wheel rims are not made of oil-quenched steel, and the freedom from fracture of wheel rim teeth, and of those of pinions which have been normalised only, confirms this conclusion.

With steel in a homogeneous unstressed condition the factor of safety is a large one. Reference was made to this in the reply to the discussion on Messrs. Walker and Cook's paper in 1921. In an experiment, static loading 40 to 100 times in excess of the normal tooth pressure failed to break the teeth. The authors have in hand at the present time a further experiment to determine the maximum safe load per inch under steady running conditions; but in the early experiments made prior to the installation of geared turbines in the Vespasian, to determine the load at which destructive wear begins to take place, the limit was found to be about 1200 lb. per inch with a 5in. pinion, or 240 times the diameter of the pinion in inches. This limit varies directly as the diameter of the pinion.

The foregoing consideration of these matters does not imply a neglect of others which are recognised to be of great importance for the successful running of mechanical gears—chief of these is the question of accurate machining, in particular the cutting of the teeth. The principal effect of an error in the cutting of the teeth is as follows: With two pinions driving one wheel, unless the errors on the two sides synchronise, it is possible for one pinion to be tending to push the wheel ahead, and for the other to hold back, and there is thus a state of war between the pinions with the inertia of the turbines behind them striving to keep them running at constant speed. To overcome this it has been proposed in some cases, where errors are known to exist in the cutting machine, to mark the pinions and primary wheels in reference to their position on the machine when cutting, and subsequently in assembling to "register" the pinions and primary wheels on one side with those on the other, so that whatever errors of angular position may come to them from the gear-cutting machines may synchronise. This has actually been done in a few instances with marked success, as judged by quietness of running. It does not, however, counteract errors in the secondary wheel. A better proposal, however, is to insert flexibility combined with damping between the main wheel and the turbines, or at any rate between the turbines. A method of doing this was described during the discussion on Dr. Smith's paper last spring. By the courtesy of Messrs. Alfred Holt and Co. it is being fitted to one set of gears of a twin-screw vessel which will shortly go into service, and actual experience of such a provision will soon be available. With devices of this kind a larger error in the gear teeth can be tolerated. Without them, a higher standard of accuracy is required to obtain quiet running gears, and it is appreciated that no effort should be spared in the improvement of gear-cutting machinery.

At the same time, the gear-cutting machines as they are at present must be credited with a very high percentage of successful gears, and in the authors' opinion most of the instances of gears being unsatisfactory, through noise, for instance, should be attributed to want of care either in overhauling the machine or in setting the work rather than to inherent errors in the master wheels of the machines. Perfect accuracy is an ideal. The question may be approached from two standpoints: How far is it necessary to go? In other words, What is the maximum error that can be allowed? Or, How far is it possible to go in the direction of accuracy? What is the minimum of error that can be attained? To this latter question the Parsons Marine Steam Turbine Company is giving very close attention, and has in hand at present improvements which will further increase the accuracy of its machines, and by these means it is hoped to reduce the maximum error of angular position for large wheels to about one two-thousandth of an inch. Regarding this as the accumulated error due to variation in pitch, it will represent an individual pitch variation (which is frequently adopted as the measure of accuracy) of the order of one hundred-thousandth of an inch. Two lines of advance are being followed, one involving a minute rectification of master wheels, while the other is the development of an improved creeping mechanism.

Hydro-Electric Project in Ulster.

We have received the following particulars concerning a hydro-electric scheme, by which it is proposed to provide a supply of electricity for distribution in Ulster:—

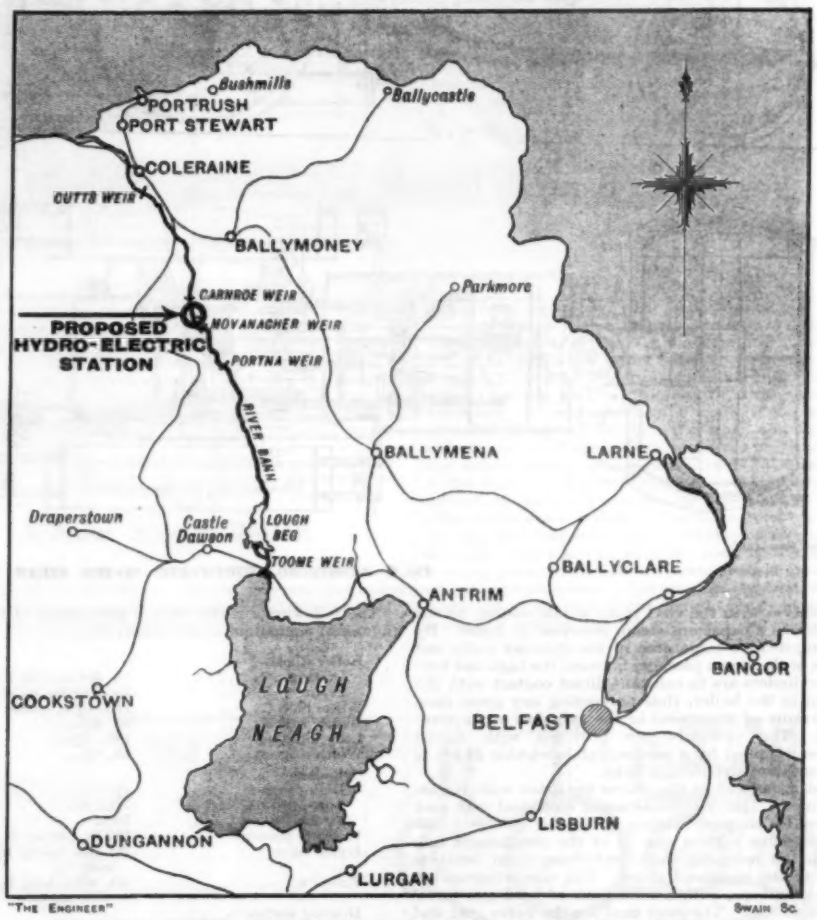
The prosperity of Ulster depends primarily on its linen industry, which find employment for thousands of people from the growing of flax to the weaving of cloth. As is well known, power forms an important factor in the manufacturing costs of linen, more than 1 horse-power per operative being absorbed. It is estimated that the Ulster linen industry at present requires 125,000 horse-power, of which 55,000 horse-power is in use in Belfast, and the remaining 70,000 horse-power is taken up by the linen mills scattered throughout the six counties outside Belfast.

The need of cheap electric power in the development of industries in Ulster has been recognised by local industrialists for some time. An important point in this connection is the cost of coal at the various linen mill centres, which is distinctly high, and likely to remain so, owing to (*a*) the magnitude of the present large and growing demand in Ireland for coal for railways, shipping and domestic purposes in comparison with the small output from Irish collieries, (*b*) the strictly limited extent of the proved deposits of coal in Ireland, (*c*) the high cost of mining Irish coal deposits, and (*d*) the high costs of delivering coal to the various industrial centres. The average yearly output from Irish coal mines for the past twelve years has only been 86,000 tons, as compared with a yearly import of 4,500,000 tons of coal into Ireland.

Under these circumstances the attention of industrialists has been drawn to the possibilities of developing cheap hydro-electric power on the river Bann, which is known to offer very favourable facilities for such a purpose, and of distributing the electric energy so generated to the various industrial towns within economic transmission distance. With this object in view, a syndicate, the Bann Syndicate, Limited, was formed last September in which the Right Hon. J. C. White and Senator T. M. Greer, representing some of the chief local manufacturers, are interested in association with a strong London financial group. Upon the formation of this syndicate, Messrs. J. F. Crowley and Partners, Westminster, acting in association with Messrs. Meik and Buchanan, were appointed consulting engineers, and a searching examination of the water-power possibilities of the river was made. As a result, a detailed scheme has been prepared and is being embodied in a private Bill to be introduced by the syndicate in the Northern Parliament.

It will be of particular interest to the many riparian owners round Lough Neagh to learn that the proposed works, which include the regulating of the waters of Lough Neagh, are not only intended to benefit Ulster by providing a cheap supply of electricity, but will also, it is stated, distinctly ameliorate the flooding conditions round the Lough, which, for many years past, have been the subject of serious complaints owing to the considerable loss caused by them to the farming community. The works to be undertaken will enable the surplus water to be got rid of quickly, and thus, it is anticipated, altogether prevent the serious inundations experienced in the past.

As regards the scheme itself, the accompanying map shows the position of the proposed hydro-electric generating station on the river Bann between the Movanagher and Carnroe weirs. The design of the scheme permits of development in stages to meet a growing power demand, beginning with a supply of 6000 horse-power, and increasing in steps until eventually upwards of 15,000 horse-power are developed. The total capital cost of the ultimate development will be something less than 1¼ million pounds, and it is estimated that power will be supplied even in the earlier stages of development in the proposed area of supply, where coal costs are considerably higher than in Belfast, at a rate very considerably below that at which power is supplied to power consumers in Belfast at present. It is believed that power demands will greatly exceed the supply, particularly in the early stages of development, and arrangements are to be made to deal with applications for power in rotation.



MAP SHOWING POSITION OF POWER PLANT ON THE RIVER BANN

RADIO TELEPHONY IN SWEDEN.

The following report, dated March 2nd, relative to radio telephony in Sweden, has been received from the commercial secretary at Stockholm:—

The Swedish Telegraph Administration—Radio Bureau—has now published its views on the general question of broadcasting. The system proposed by it conforms more or less to that adopted in England. A licence fee will be collected for each instrument sold, but no renting of receiver sets, on the lines of the scheme proposed by the "Svensk Radio," and associates in their application for a concession will be agreed to. The licence fees will be paid to a single large broadcasting company, which will arrange the programme under a concession for a term of five to ten years. The Government will establish broadcasting stations, at first in Stockholm, Gothenburg, Malmo and Orebro, and later in a number of other towns. These will be rented by the broadcasting company. All the applications for broadcasting concessions have been refused, as the Telegraph Board desires that a special company shall be formed for the purpose. In order to foster a Swedish radio telephone industry it is proposed to protect it from foreign competition for a period of two years on lines similar to those adopted in England. Installations already existing will be allowed to remain upon payment of the licence fee.

The broadcasting stations, which it is intended to erect, are intended to be of a power of 1 kilowatt, and ten such stations are proposed, the first to be built being those in Stockholm, Gothenburg, Malmo and Orebro, and later on stations in Kalmar, Falun, Sundsvall, Ostersund, Umea and Lulea. The initial cost of each station is put at Kr. 115,000. They will work with a wave length not exceeding 425 m. Seven hours a day will be allotted to the broadcasting programme of the company, and one half hour is to be reserved for the use of the Government, between 6 p.m. and 9 p.m., in case it wishes to make any announcement in this way. Advertising by broadcasting will not be permitted. Certain alterations in existing wireless legislation—law of March 31st, 1907—will be necessary, and the Telegraph Administration has, therefore, requested the Government to lay that question, together with its proposals, before the Riksdag now assembled.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Business Interrupted.

THE approach of the Easter holidays resulted in quieter market conditions this week at Birmingham. Producers and consumers alike discussed the general position, and it was generally agreed that, quite apart from the holidays, the normal flow of business has been seriously interrupted by the shortage of raw material and the rapid advance in prices. There is no doubt that buying has been postponed in a great many cases in the expectation of a relapse. The shortage of raw material is throwing the finished branches out of their stride, for, apart from arranging new supplies, consumers are harassed by the irregularity of deliveries against unexpired contracts. While high prices are paid by manufacturers in order to escape from tight places, there is no confidence in the market. As regards the immediate future there is no anticipation that the stringency which obtains in all departments of the market will be relieved. The whole matter turns upon possible developments of the continental political situation; but even should the crisis come to an end, it will take some time for the market to recover its equilibrium.

Blast-furnaces to be Re-lighted.

I learn that as the result of the trade improvement and in order to cope with the present enormous demand for pig iron, four more blast-furnaces are to be re-lighted at Stanton Ironworks, Derbyshire. Midland iron is so scarce at date that the enterprise shown meets with general approval, and Staffordshire ironmasters are hoping to secure a fair share of the output of these re-lighted furnaces.

Pig Iron Situation Unaltered.

The pig iron situation, apart from the re-lighting of the Derbyshire furnaces, remains much as last week, and practically all Midland irons are off the market. Furnace owners, with the ever-increasing scarcity of coke and the high price demanded for it, are hard put to it to keep their regular customers supplied. In this locality there is an absolute famine. Forge sorts are especially scarce, but neither forge or foundry qualities can be bought on any considerable scale. Consumers consider themselves fortunate if they get an allowance of 20 tons or so now and again to supplement their previous purchases. Merchants who in normal time rely largely upon buying in the open market to keep up with their contracts for delivery are still more seriously handicapped, as any lots that come into the open market are eagerly bid for by continental buyers. The majority of pig iron producers have closed their books for the time being. Meanwhile, the position is so nebulous that prices cannot be defined with any degree of certainty; but Derbyshire No. 3 foundry iron is certainly not less than £5 5s. at furnaces, and most quotations are higher by 2s. 6d. to 5s. The prospect of re-opening Staffordshire furnaces is not very bright. The pressure from abroad for coke continues unabated, and is creating a state of things in regard to fuel which makes matters more than ever difficult for smelters. No one knows from day to day what the price of furnace coke is going to be. All the coke that can be spared is being snatched up by foreign buyers, whose search for fuel is stated to have extended to America. There has been considerable talk of recommissioning disused coke ovens, and hopes are entertained that their output will be available for blast-furnaces at home. It would be rash to build too much on this, however, as the condition of most of these ovens is such that relining is a necessary preliminary of effective service.

Mounting Steel Values.

Business in the steel trade amounts to a small boom, the result being that values continue to harden. Under the influence of the recent advances in ship plates and sections made by Scotch producers, sellers on the Birmingham market to-day (Thursday) asked and obtained higher prices for most descriptions of steel material. All the local rollers of angles and joists are now quoting £10 5s., the exception noted last week no longer applying. Staffordshire steel hoops are dearer by 20s. per ton than they were a week ago, being now based on £13 at works. Steel bars, which are in keen demand, are quoted £11 upwards, and the tendency is for them to become dearer. Even at this price steel bars are so much cheaper than iron that they offer an attraction to nut and bolt manufacturers, whose plants are adapted to their use. The position with regard to sheet bars and billets has been under review by the South Wales interests. It is stated that mills are establishing a closer supervision of sales. For sheet bars £9 minimum is required. There is no dead level for soft billets, £9 10s. and upwards being quoted. Hard billets have advanced 10s. to £10 15s. Inquiries are very active, whilst supplies tend to fall off. There is a dearth of good steel billets. Sheet bars are feeling the effect of the boom in the Welsh tin-plate trade, and further price increases may be expected shortly. Steel gas strip can only be bought at anywhere round £12 when big quantities are ordered. Foreign material is falling off in supply, but some billets from Luxembourg are available at about £9 2s. 6d. delivered in the Midlands for April and May. As far as Belgium is concerned, deliveries, except under contracts made some time ago, are rapidly coming to an end.

Steel Wire Prices Advanced.

Wire rods continue to go up and are scarce to-day at £12 10s. As a consequence another advance of 20s. a ton has been notified in mild bright steel wire, raising the basis to £22 in hundredweight and half-hundredweight coils. Till very recently bright wire was selling at £20, and large orders were booked at that price. The mills have sold practically all their output over the next three months, and prompt lots are hardly to be got now. The advance in other descriptions varies, being as much as 30s. in the case of mattress wire, although that branch lags behind some of the other branches in the matter of activity.

Finished Iron Prices.

Prices of finished iron still show a soaring tendency, all classes of bar iron being in strong request. Staffordshire Crown bars of best quality are firm this week at £12 10s., while marked bars are steady on the new basis of £14. Nut and bolt bars of Staffordshire make can still be bought at £11 10s., but Lancashire firms who do business here keep stedfastly to the £11 15s. quotation, their contention being that any extra profit has been more than swallowed up by increased production costs. The Midland quotation for iron flats is £13 at works. The business being done is largely confined to district trade. There is little continental material coming into the district, even though Belgian firms continue to quote £10 2s. 6d. to £10 5s. for nut and bolt bars delivered Darlaston.

Keen Demand for Scrap.

There is keen inquiry for all kinds of scrap and the supply is rapidly diminishing. Cast iron, wrought iron, and steel scrap are all dearer, being quoted at prices above £5. Owing to the scarcity of pig iron, cast iron scrap is this week being quoted £5 to £5 2s. 6d. Wrought iron scrap rules about half a crown dearer, but in some cases as much as £5 10s. is asked for good-class material. Heavy steel scrap is easily sold at £5 in the Midlands.

Galvanised Sheets Advanced

Galvanised corrugated sheets, the quotations for which have recently showed considerable divergence, have this week been advanced by many Midland makers 10s. per ton, bringing them up to £20. Business is, however, passing in some quarters at £19 10s. to £19 15s., but even these prices are an advance on those ruling last week.

Wages in the Wagon Building Trade.

Midland engineers interested in the railway wagon building and repairing trades are anxiously awaiting the result of the ballot on the proposed stabilisation of wages rates now being taken. The workers' organisations concerned comprise the Amalgamated Engineers' Union, Associated Blacksmiths' and Ironworkers' Society, Amalgamated Society of Railway Vehicle Builders, Amalgamated Society of Woodcutting Machinists, Boilermakers' Society, and Workers' Union. After all the efforts that have been made to come to agreement and the concessions which the employers have made during negotiations it would be, in the opinion of industrialists here, very unfortunate if an adverse vote compelled the employers to enforce the proposed reductions, as it is realised they must do in the interests of the trade.

Chain Trade Improvement.

There has been a marked improvement in the chain trade in the Rowley Regis district, particularly in the larger sizes, as is evidenced by the large quantities sent to the Government testing house. Here the employees are working six days a week for the first time since the depression started shortly after the conclusion of hostilities. The orders for smaller sizes are not so brisk, though this side of the industry is brighter than it was a month or two ago, and many hearths which have been idle for a long period are once more in use.

Edge Tool Industry.

The heavy edge tool industry has experienced an unusually good run of business since the start of the year, but the tone of the market has been quieter during the past few weeks, although inquiries for the future are fairly good, and, on the whole, there is a steady improvement. India maintains good business, but Brazil and South America are not the fruitful markets manufacturers would like to see them.

Engineering.

The steady improvement which commenced at the beginning of the year in the engineering and brass-foundry trades of the Midlands continues. In engineering circles the mechanical and electrical firms welcome the activity of the various municipalities and electricity supply concerns. Tenders for all kinds of apparatus and equipment are now being asked for, but there is no news of any substantial municipal installations. Constructional work is proceeding apace, and the majority of Midland firms are well off for orders.

Improvement in Shropshire Industries.

Matters industrial in Shropshire are becoming brighter, and this week reports are to hand of the re-starting of steel works at Oakengates, which have been idle for more than two years, by the Lilleshall Company. Additional orders and inquiries are being received at the iron and steel works, and at Messrs. Walker's Donnington Midland Ironworks more men are being employed than was the case a few months ago. The outlook in Shropshire is considered very satisfactory.

The Unemployment Barometer.

In the West Midlands area the records of the Labour Exchanges have shown a steady diminution since the first week in January. There were then 176,548 on the books and 57,093 of those were in the Birmingham area. The latest returns, which show a stronger recovery in the Midlands than in any other area in the kingdom, give a total of 136,321, of whom 44,763 are in the Birmingham area. Since the beginning of the year work has been found for 12,330 in Birmingham alone. Throughout the West Midlands in the same period there have been re-absorbed into industry 40,236.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron, Steel, and Metals.

THERE is a sharp difference of opinion here as to the cause of the lull in the iron and steel trades, and partially also in the metal trades, which has come over the market. A good many people attribute it entirely to the approaching Easter holidays, and are quite confident that there is no other more serious reason to be apprehended. On the other hand, there are some who, realising that the higher prices and larger demand for iron and steel have been caused entirely by the continental demand and the cessation of continental competition in the export trade, believe that the lull is caused by the apprehension that some arrangement between France and Germany is coming, which will bring about the resumption of output on the Continent. The "holiday theory" will, of course, be capable of proof after next week, but we may have to wait longer before it is clear whether or not the iron and steel industries of Germany, and those other industries which depend upon German fuel, can be brought again into working order. Meantime, trade in Manchester is certainly quieter, and rather less confidence is expressed as to the permanency of iron and steel prices.

Metals.

The market for standard copper remains steady, but rather quieter. There seems to be a feeling on the London market that the advance has gone quite far enough now, and probably farther than can be justified by any real improvement in trade. Speculators on this side, however, still hesitate a good deal as to whether the time has come to open a "bear" campaign against standard copper. The fact is that they are deterred not by the state of trade, but by the uncertainty as to the course which American interests might adopt. Some considerable buying of refined copper has occurred lately, not only by British consumers, but by Germany, Italy and France; but so far as the British buying is concerned, it has been known for a long time that consumers were bare of stock and had been working their businesses on a hand-to-mouth principle. The substantial advance which has taken place since December may have induced many consumers to reconsider this policy; and, if so, the larger buying in Great Britain is accounted for without assuming that there has been any increase in the consumption. Further small advances have been made in the official prices for manufactured copper and brass. Solid drawn copper loco. tubes have been put up to 1s. 2¾d. per pound, and brass loco. tubes to 1s. 1d. per pound. Brass condenser tubes are 1s. 2¼d. per lb., and brazed brass tubes for the home trade, 1s. 2¼d. per pound. Strong copper sheets and rods are at £106, but 4 by 4 copper "braziers" for the Indian market are only £95 per ton. In scrap copper, gun-metal and brass the tendency is upward, although prices are still comparatively low. The market for tin has been erratic, and it is far too dangerous to attempt any forecast as to what is likely to happen. There has, however, been some expression of market opinion lately to the effect that the top of the market has been seen for the present. The advance of prices to over £230 per ton at one time did not lead to the liquidation of any of the stock held by the F.M.S. Government, and this metal remains more or less a danger, for no one can tell when it might be released. The markets for lead and spelter have been without any serious change. The fear of a stoppage in the building trade had rather a depressing effect at one time. The demand for spelter from the galvanising trade is rather quiet at the moment.

Pig Iron.

The market for pig iron in Manchester this week is very quiet, but so far there has been no weakening of prices. The Derbyshire blast-furnaces quote usually 107s. 6d. on trucks, which is now equal to about 116s. per ton delivered in Manchester. It is, however, sometimes possible to buy at 115s. delivered here; but, as a matter of fact, very little foundry iron has yet been sold in South Lancashire at these higher prices. Consumers are postponing their orders and working on the iron which has yet to come in at about 20s. per ton less; but there is no doubt that some of them will have to buy after the Easter holidays, say, by the second week in April. Midland pig iron is still going away in small quantities to North Yorkshire, but one does not understand that very much business has been done in that direction. The prices here for Scotch No. 3 and hematite pig iron remain at from £7 to £7 5s. per ton delivered, but practically no business is being done in these irons at the moment.

Steel.

The announcement at the end of last week to the effect that all Scottish steel prices were put up by 15s. to 20s. per ton did not have much effect here, where the general run of steel prices was already about that amount above the quotations in the North. Here the price for round bar steel remains at £12 per ton, and one imagines that to put it higher would be unsafe. Common steel plates are quoted at £11 to £11 10s. per ton, and steel angles at £10 5s. to £10 10s. Business has fallen off this week, but makers maintain that they have plenty of work to go on with. The prices for semi-steel are very firm, and up to £10 per ton has now been quoted for soft basic steel billets. Lincolnshire basic pig iron has been quoted at £6 at the furnaces.

Scrap.

The market for steel scrap in Lancashire does not advance in full accordance with the upward movement in steel-making pig iron. Dealers here find a difficulty in getting more than £4 15s. per ton for good heavy steel melting scrap, whereas it ought to be worth as much at least as basic pig iron. There has been rather a better inquiry lately for heavy wrought scrap, caused perhaps by the much higher prices demanded for forge pig iron. Lan-

cashire ironworks have now to pay from £5 5s. to £5 7s. 6d for Midland forge pig, and any scrap they can get at £5 is, of course, cheap iron-making material. Business in foundry scrap is slow, and dealers cannot find buyers for all the good machinery cast scrap they have to offer at £5 per ton. Some dealers are still accepting £4 15s. for this class of scrap, in spite of the fact that common pig iron is at £5 15s.

The Engineers' Club.

At the annual general meeting of members of this popular Manchester institution, held on Tuesday last, Mr. John Taylor, C.B.E., director of Mather and Platt, Limited, was elected President for the ensuing year to succeed Mr. J. S. Webb, who has filled the post for the past two years. The Committee's tenth annual report shows the club to be in a very sound condition, notwithstanding the loss of revenue compared with the previous year, due to the general trade depression. The membership is well maintained, being in the neighbourhood of 800, of whom nearly 700 are town members. A gross revenue of over £18,000 indicates the extent of the club's activities, but the club lays no claim to being a profit-making concern. It can only justify its existence by providing a place of meeting and recreation for the engineers of this great manufacturing centre, and this it has done. One of the greatest improvements which the Committee has made during the past year is the provision of ladies' quarters, which will be greatly appreciated by members' wives. During the coming year further additions will be made, first, for the convenience of the members, and, secondly, to enable the club to afford facilities to the technical societies for their meetings.

Manchester Association of Engineers.

At the annual meeting of this society, held on Friday last, Mr. Cecil Bentham, M.I. Mech. E., director of Henry Simon, Limited, was elected President for the year 1923–24, to succeed Mr. Daniel Adamson. Mr. Bentham has been a member of the Manchester Association for some years, and has taken a prominent part in the debates. During the past session he contributed a paper upon the "Separation of Materials by Mechanical Means," which was a very valuable contribution to the literature on this subject. At the same meeting Messrs. J. Bates, W. Webb, R. Onions, E. Simpson, and G. Windeler were elected members of Council.

BARROW-IN-FURNESS, Thursday.

Hematite.

The constant anxiety about coke is a disturbing element in the hematite pig iron market. Just when one is satisfied that the present number of furnaces are receiving their proper supply of coke and are not likely to be interfered with there comes a sudden stoppage in supply, with the result that furnaces have to be temporarily damped down. Last week, when there seemed to be no clouds in the sky, there suddenly developed a black patch and Millom had to stop for a few days. At a time like this, when the volume of trade demands exceeds the output such interferences are most tantalising. The amount of possible business could easily find work for several more furnaces, but when coke cannot be had what can be done? There is also a spirit of caution amongst the smelters, who realise that if the trouble in the Ruhr Valley is overcome there will be a falling off in continental trade. On the other hand, there is bound to be a certain amount of trade in hematite with the Continent, and at the same time the demands of British customers are increasing as shipbuilding and engineering orders are being booked by them in increasing volume. Makers are not very anxious to book for forward deliveries under the circumstances, and only regular customers get any consideration; continental, none. The shipments of pig iron from Barrow have been for Glasgow mostly.

Iron Ore.

The iron ore trade has a fair amount of business' which is restricted by the fact that the number of furnaces in blast has to be kept down through lack of coke. The Cumberland mines are fairly active, and there is a little more going out of the district than heretofore, including a part cargo for Antwerp last week. Foreign ore is coming in more regularly now that the local stocks are reduced.

Steel.

The steel trade is only moderate, and the greatest activity in the district is centred at Barrow, where the rail mill continues. The hoop and small bar mills are active. There is little activity at the steel works in Cumberland. A considerable amount of work at the Barrow steel works is on British railway account. A cargo of steel billets from Antwerp arrived at Barrow last week.

Shipbuilding and Engineering.

Work is progressing favourably on orders held by Vickers Limited, and the Orient liner is beginning to take shape on the stocks. Messrs. Vickers have made an appeal to their men to put in their best inasmuch as the recent orders have been booked at low prices, it being their desire to reduce unemployment as much as possible. Vickers have secured an order for important repairs to the Elder-Dempster liner Fantee. It includes renewal of hatch plating and stiffening in way of hatches and general overhaul and reconditioning.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel and German Orders.

The sharply contrasted conditions in the steel trade, to which I have referred on several occasions, still continue. While there is a boom in the heavy department, there is pronounced slackness in the lighter branches, producing a state of affairs which is altogether new in the city's experience. The open-hearth furnaces are in many cases working day and night turning out great quantities of billets. The placing of new business, however, is showing signs of falling off, a fact no doubt attributable to the recent rapid rise in prices. The makers are not at all alarmed at this, as they have so much work on hand, particularly in the matter of soft steel, that they are not anxious to book further business at present. It would be easy to obtain a large volume of orders from Germany and other continental markets; but producers here are acting warily with regard to the acceptance of these, in view of the risk of the contracts being cancelled in the event of a settlement of the Ruhr question, with consequent restoration of German manufacture.

An American Order Refused.

The pressure of work applies also to the rolling mills, which have more on hand than they can conveniently handle, and are finding it difficult to secure all the steel that they require. An example of this has been afforded during the week by the action of the Sheffield Forge and Rolling Mills, Limited, in declining to entertain an inquiry to manufacture no fewer than 300,000 steel bars, to be used in agricultural machinery, for an American firm. The forge is quite full of work, and, in the words of its managing director, "There is not enough steel to go round." The fact that the inquiry came from America was not likely to induce a Sheffield firm to exert itself unduly in order to accept it, as the Americans, in imposing the Fordney tariff, showed scant concern for the welfare of the city's high-speed steel industry.

The Lighter Steel Trades.

It is in high-speed steel and other expensive qualities that the unsatisfactory side of the present position shows itself. There is very little improvement to be noticed here, and some of the firms find work actually falling off to an even lower level than it has reached hitherto. In the engineers' small tool department things could not well be worse. The file trade is still very slack, though a little improvement is reported in the demand from overseas. Saw makers are picking up a somewhat increased amount of business, but they have not enough on hand to keep the factories fairly well employed. A better state of things obtains in the wire trade, which is in a healthier condition than at any time since the slump began in the autumn of 1920. Work is being booked on an increasing scale, and the outlook for the year is considered highly promising. There is nothing new to say about cutlery, except that a rather better inquiry for pen and pocket knives and razors is being received by a few firms. Generally speaking, these sections continue very poorly employed, and the only active branch is table cutlery, which continues to sell fairly freely.

Sheffield and Smoke Abatement.

The Sheffield steel trade occupies a peculiar position as regards the making of smoke, it being contended that black smoke is necessary for the production of high-carbon steels. The manufacturers are therefore anxious to secure protection in the new smoke abatement legislation which is proposed, and a large and important deputation last week waited upon the Ministry of Health with regard to the matter. They saw both the Earl of Onslow, Parliamentary Secretary to the Ministry, and Lord Newton. Mr. J. E. Baker, chairman of the Sheffield Engineering Employers' Association, presented a report, signed by all the firms engaged in the steel industry, pointing out the absolute impracticability of eliminating smoke with the knowledge at present at their disposal. Unless protection was forthcoming the whole of the Sheffield steel trade would be jeopardised. The Earl of Onslow, in reply, assured the deputation that the Government did not desire to produce legislation which would imperil industry, and he would welcome suggestions for adequate protection. The deputation then suggested that protection should be in the form of a definition of defence like that incorporated in Lord Newton's report, namely, that the defendant was using the best practical means at a reasonable cost to obviate any nuisance, and that the whole circumstances of the case should be considered before prosecutions were made. It was also suggested that the clause in the old Bill dealing with the creation of by-laws regarding new buildings should not apply to process construction, such as furnaces, but should be definitely limited, as was the intention, to buildings in which heat was being produced for warming the atmosphere as distinct from process work.

Waterworks Extended.

The Sheffield Corporation's Water Charges Bill has been before a Select Committee of the House of Commons, and as a result of an arrangement made there the Corporation is to take over the present waterworks at Chapeltown from the local District Council. The terms are to be agreed upon by the parties, or, failing agreement, to be settled by an arbitrator appointed by the Ministry of Health. After June 24th next the District Council will cease to supply water in detail in its area, as by that time the city will have purchased all the works, tanks, pipes, &c.

Rother Valley Water Scheme.

Progress is being made with the consideration of a scheme for pooling water resources in the Rother Valley, in the interests of a number of places in the Chesterfield district. The Ministry of Health recently brought the matter forward and suggested the advisability of an arrangement by which all the available water could be stored for the benefit of the whole area, which contains a population of about 140,000. At present the Chesterfield Rural Council has more water than it can store, while the Chesterfield Corporation has storage capacity to spare. The engineers for the two bodies named, in conjunction with the engineer for the Blackwell Rural Council, have now drawn up a joint report, in which they estimate the water requirements of the various places concerned at 430,000 gallons daily, and suggest that it would be necessary to take the water from the bore-hole undertaking of the Chesterfield Corporation. This would necessitate an extension of the proposed pumping station at Whispering Well, with pumping plant in duplicate, to lift water from the proposed service reservoir at Whispering Well, at a level of 558ft. above Ordnance Datum, to a proposed service reservoir at approximately 700ft. above Ordnance Datum between Holymoorside and Walton. There would also be needed a 10in. pumping main from the above pumping station to the service reservoir; a covered service reservoir of approximately 800,000 gallons capacity; and a 12in. main from the above reservoir to the cross roads at New Tupton.

Scunthorpe's Railway Difficulty.

Now that the trade of Scunthorpe and Frodingham is returning to normal channels, the importance of improving the railway facilities of the two places is being strongly urged. At present much congestion is caused by insufficient siding accommodation, most of the traffic from the works having to pass through a "bottle neck" before it reaches the main line. It is now authoritatively stated that Sir Berkeley Sheffield, Bart, and Mr. Wedgwood, general manager of the London and North-Eastern Railway, were present at a recent meeting of the Lincolnshire Ironmasters' Association in London, at which a plan was definitely agreed upon, to be undertaken at once, to relieve the congestion of the traffic in and out of the works. The further alterations at Scunthorpe—bridge over the road, new station, &c.—will require parliamentary powers, and are now under consideration. If these alterations are decided upon they will be included in the London and North-Eastern Railway Bill, which will come before Parliament about the end of this year.

Scarborough Cliff Troubles.

The seriousness of the position created by the extensive landslide on the North Cliff at Scarborough, with its threat of the destruction of the Royal Albert Drive, is emphasised by a report submitted to the corporation by Messrs. Coode, Fitzmaurice, Wilson, and Mitchell, whom it has consulted. The firm regrets that it is unable to make a definite recommendation as to work which would be a final and complete remedy against the troubles which have occurred, that not being possible owing to the deep-seated nature of the movement. The existing conditions are of an exceedingly serious nature, and it would not, in its opinion, be practicable, except possibly at prohibitive cost, to adopt any remedial measures reaching to the root of the disturbance. It recommends the construction of a heavy semi-circular bay wall, extending 200ft. seawards, at an estimated cost of £81,000. The wall would be similar in character to a reclamation sea wall constructed for the Admiralty Harbour at Dover. As an alternative scheme the firm suggests the construction of a "wave breaker," comprising 15 to 20-ton blocks placed at the front of the affected portion of the wall, which, it is believed, would effectively prevent a serious breach in the wall. The Town Council has decided to apply to the Ministry of Health for sanction to borrow £25,000, the estimated cost of the removal of the flagstaff mound in the Clarence Gardens, which is believed to be one of the causes of the dislocation of the sea wall.

NORTH OF ENGLAND.

(From our own Correspondent.)

Furnaces Damped Down.

It is very unfortunate for industry on the North-East Coast, that at the time when trade is reviving and the works are becoming more actively employed, the inadequacy of the railway transport facilities should once more lead to dislocation. At the Lackenby Ironworks, near Middlesbrough, two blast-furnaces have been damped down this week owing to the accumulation of large stocks of pig iron. The primary cause is the shortage of trucks, which has meant that stocks have accumulated until the works have been obliged to cease making iron. The fact that the furnaces are only damped down and not blown out gives hope of an early resumption, but this depends upon future circumstances. The belief that trade is slackening seems to be disproved by the fact that Pease and Partners, Limited, the owners of the Lackenby Works, have re-started another blast-furnace at their Skinningrove Works, which have now reached a state of almost full activity. There are now four blast-furnaces in operation at the works engaged on the production of Cleveland pig iron.

Cleveland Iron Trade.

Great firmness continues to characterise the Cleveland pig iron market, though there has been a lull in the inquiry this week and the business transacted has ruled within narrow limits. Hope and belief that the trouble in the Ruhr Valley may be speedily settled have tended to slacken inquiry from the Continent, notwithstanding the obvious fact that considerable time must elapse before anything like normal working conditions can be restored in that quarter for competition in the markets of the world. The fact, however, that there is a belief of possible settlement is undoubtedly creating a spirit of caution. As a result a large shrinkage in continental inquiry is very noticeable. But prices show no sign of weakening—hematite has, in fact, advanced—and the position of the makers is one of phenomenal strength. Whatever happens, they will have little iron to sell before the second half of the year, and the damping down of the Lackenby furnaces is not going to help matters. Continued scarcity of supplies is, in fact, inevitable, for most of the makers have no iron to sell before June, and buyers in urgent need are completely at the mercy of the market. The damping down this week of two blast-furnaces and the re-kindling of others leaves the number in operation on the North-East Coast still at forty-five, of which eleven are producing Cleveland pig iron, eighteen are making hematite pig iron, and sixteen are manufacturing other kinds of iron. No. 1 foundry iron is quoted at 130s.; No. 3 G.M.B. Cleveland, 127s. 6d.; No. 4 foundry, 125s.; and No. 4 forge, 120s., f.o.b. or f.o.t.

Hematite Pig Iron.

Makers of East Coast hematite pig iron are also in a very strong position. With only eighteen furnaces in operation producing iron, of which a considerable proportion passes into the adjacent steel works, the supply of iron for the open market is very limited. Producers are well sold over the next two months, and they are by no means keen on committing themselves heavily for delivery any further ahead, seeing that costs of production are steadily rising. East Coast mixed numbers have advanced to 127s. 6d. per ton, and some makers ask even more. No. 1 is at a premium of 1s. per ton.

Iron-making Materials.

The foreign ore market is quiet again after a period of active business, and prices show a weakening tendency. Business is now possible in best Rubio ore at 24s. 9d. c.i.f. Tees. The coke market is very firm. Export prices are still at a phenomenal level, and the temptation to the coke maker to export coke and cut the ironmaster down to the bare minimum is very great. Good medium furnace kinds are at a minimum of 40s. per ton delivered at the works.

Manufactured Iron and Steel.

The steel trade reports are all of an encouraging nature. There is practically no foreign competition at the moment and manufacturers are simply deluged with inquiries. The export demand is improving and the rail mills in particular are working at full pressure. There is, moreover, a continued pressure for supplies of semi-steel and demand really exceeds supply. Quotations are firmly maintained.

The Coal Trade.

The Northern coal trade position has shown a slight improvement since last week, and there has been a stiffening of prices. From now to the end of April the position is generally very firm. The improvement in the tone of the market is to be attributed in some measure to the rather optimistic view taken in certain quarters of the possibility of a satisfactory settlement of the Ruhr question. This, it is thought, will allow of a safer and more reliable estimate of the forward possibilities of the market, thereby inducing prospective buyers to come forward and obtain their quantities at something more like a stable figure than is possible in the existing state of uncertainty. There are, however, numbers of people who hold the opinion that, if this settlement takes place on a workable and satisfactory basis, the effect on this market will be the reverse of beneficial to sellers, and that we may look forward for something approaching a collapse within two or three months at the longest. There is practically no new business on offer from Germany at the moment, but there are improved inquiries from France, Italy, Denmark, Norway and Sweden. The loading turns at the various staithes and docks are full. Congestion is the rule, not only at the public, but at the private staithes, which is causing no end of delay to steamers, and considerable expense for demurrage to the shippers. Part of the rush for early loading is due to the approach of the Easter holidays. As the output at the pits will be diminished the conditions over the next week or two are likely to be very tight and firm all round, more especially as there is considerable congestion reported, not only on the Tyne and Blyth, but also in the Humber and at Scottish ports. Northumberland steam coals are very firm for all dates of loading up to May, both large and smalls being indicated at top figures. A marked improvement is observable in the Durham gas coal section. Special gas and prime sorts are well sold, while second-class gas coal has firmed up considerably. Coking coal is rising in price and bunkers are steady in every instance. There is no change in the coke trade, and all brands of foundry and gas makes are very steady.

SCOTLAND.

(From our own Correspondent.)

General Strength.

In the steel and iron trades generally little change has been apparent for some weeks, and the past week has been no exception. Up to the present the rise in prices has, on the whole, had little influence on business. In some departments business has been a shade quieter, while in others an expansion has taken place. The situation on the Continent is still diverting orders to local makers, though a shortage of raw materials occasioned by the same circumstance is a considerable drawback. Outputs of most classes of materials are restricted, and with export inquiries on the increase, the level of prices is easily held, and the tendency is still upwards. It would appear as though firmer prices have checked the progress in the shipbuilding industry. Contracts are now few, though still occasionally reported, while inquiries have been drastically cut down. So long as foreign buyers are busy the less active conditions in the shipbuilding trade may not affect local works to a great extent, but if the latter were depending on home consumption a different story would have to be told. Meantime, however, manufacturers are reaping the benefit of the cutting off of continental supplies, and all materials are firmly held.

Pig Iron—Scarce and Firm.

The market for pig iron continues strong. The home demand for hematite and foundry qualities is fully maintained, and the export inquiry is very fair. Outputs are none too plentiful, and with these quickly absorbed, quotations show a firm attitude with an advancement practically every week.

Steel and Iron.

The steel works are comparatively well placed, and outputs are nearing normal capacity. Apart from the check to buying of shipbuilding materials, there is no apparent slackening in demands. Sectional materials are heavily bought, and employment in this connection is said to be assured for about four months ahead. Steel sheets of all gauges, and especially of the lighter varieties, are very active. Home demands are fairly brisk, but the Far Eastern inquiry is particularly heavy. Bar iron makers are increasing their bookings, despite higher prices. Home requirements are expanding, while export orders bulk largely. The re-rolled steel branch of this industry is having its full share of attention, and would welcome a better supply of imported billets. All descriptions of scrap material are in short supply, and holders have very firm ideas of prices. Offers of competitive Belgian productions have been reported, but the delivery dates mentioned are not calculated to influence buyers at present.

Quiet Coal Markets.

The heavily sold nature of the collieries, with a consequent absence of prompt supplies, has had a quietening effect on the market generally. Second-hand lots have occasionally been offered, but there has been really nothing of any consequence available for early delivery. Forward buying, too, has apparently slackened off somewhat, as buyers are less disposed to pay the current rates for deliveries so far ahead. An adverse feature at present is the continued congestion at the loading ports on the East Coast, and particularly on the Firth of Forth. Delays to steamers have meant the holding up of transport, resulting in a scarcity of empty wagons and heavy demurrage liabilities to exporters. Another result is that buyers having a boat in position for loading can gain price concessions from the collieries. Shipments have fallen, the figures from Methil alone showing a drop on the week of over 27,000 tons, notwithstanding the fact that one steamer left with a record cargo of 9000 tons. Prices are all firm, and practically unchanged from last week.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

TAKEN on the whole, there is not much change in the conditions prevailing in the steam coal trade, except that there are evidences that holidays are approaching, and for this reason there is a noticeable slackening in the amount of actual business being transacted. This is not altogether due to the fact that the business is not available, but more to coals being absolutely unobtainable for prompt shipment. It has been a difficult matter to get supplies for early loading for several weeks past, but as Easter approaches colliery salesmen set their faces more stedfastly against accepting any further commitments, more especially as the trouble in the coalfield last week has thrown many of them further back than ever in executing their obligations. It is safe to say that for a week or more past all that has been done in steam coals for loading this side of and immediately after the holidays has been in very small parcels to complete cargoes, and for these buyers have had to pay pretty well top prices. There is still a fair inquiry, but it is questionable whether it is anything like what was experienced a week or two ago. The German demand is not so active, and there is a tendency for buyers in other directions to come along only for their most pressing requirements and to defer operating for later needs in the hope and belief that present prices will not be maintained. It does not look as if prices can weaken to any material extent, considering the heavy commitments of collieries over the next month or so. There is no doubt that they are very well sold, and they are not in a hurry to take on fresh business, seeing that next month is a short one, and that during the first week production will suffer severely as the result of the holidays.

Non-Unionist Trouble.

As was anticipated last week, the trouble at the collieries in the Maesteg, Ogmore and Garw districts came to a finish before the end of the week. The efforts of the Miners' Federation officials to rid their area of the non-unionists were very successful, and as a consequence work has been resumed at practically the whole of the collieries in the districts. As a matter of fact, at a meeting of the executive of the Miners' Federation on Saturday last it was stated that all the non-unionists had come into line and that members of the new craftsmen's union had gone over to the miners' organisation. The Council congratulated the officials of the districts concerned on the successful result of their efforts. As regards the notices which were served in the Rhondda area at the beginning of last week, it is very difficult to say what will be the outcome, nor will anything be known until to-morrow (Saturday). When the notices to terminate contracts were served it was estimated that there were between 6000 and 10,000 non-unionists among the 40,000 miners in the Rhondda. Reports so far show that the non-unionists are returning to the fold, except that rather more difficulty is being experienced with the members of the Mechanical Workers' Union. The feeling is becoming more confident that there will not be a strike next week, but the officials of the miners' organisation are pressing their campaign against those outside their Federation with the greatest vigour, and they evidently mean to make a clean sweep this time.

Steel Workers' Wages.

The announcement is made by the joint secretaries of the South Wales and Monmouthshire Iron and Steel Workers' Sliding Scale Board that the result of the recent audit for the three months ending February 28th last shows an increase in the average net selling price of 2s. 7.93d. per ton as compared with the three months ending November 30th, 1922. This gives an increase to the workmen who follow the iron and steel workers' sliding scale of 1¼ per cent., which will take effect as and from April 1st of this year. The wages therefore from April 1st to June 30th will be the standard rates plus 32 per cent., the percentage to the end of March being 30¾.

Current Business.

Actual business on the steam coal market has been much quieter owing to coals for prompt shipment being practically unobtainable, this being especially the case with small coals. Most people have been concentrating their efforts on getting away the shipments that they have undertaken; but there is every indication that quite a large number of steamers which were in dock at the early part of this week will not be able to finish in time to sail before the holidays. The congestion is still most acute. Sales that are taking place are only in respect to small parcels, for which buyers have to pay pretty full prices, which, in the case of the best Admiralty large, may be anything from 37s. 6d. to 40s., while second qualities command from 35s. to 37s. 6d. The market is in all the circumstances nominal, and there is not much likely to be done in the way of fresh business until the week after Easter, when colliery salesmen will be able to gauge their position better in the matter of supplies. Anthracite coals are rather stronger and patent fuel is quoted higher at 40s. to 47s. 6d.

The Late Mr. W. W. Hood.

The death is deeply regretted in South Wales coal-owning circles of Mr. W. W. Hood, who was formerly the managing director of the Glamorgan Collieries. Mr. Hood fell from the Great Western Railway express on Friday evening, from Paddington to South Wales, near Shrivenham, Berkshire, and was killed immediately. He was sixty-five years of age, and was the son of the late Mr. Archibald Hood, the Scottish coalowner of Kilmarnock. He succeeded his father as managing director of the Glamorgan Coal Company and as a director of the Barry Railway Company and the Vale of Glamorgan Railway. When the transfer of the Glamorgan Coal Company to the Cambrian Combine took place his proprietary interests in collieries in South Wales ceased, but he remained a member of the Conciliation Board, to which he had belonged since its formation. He was chairman of the South Wales Coalowners' Association in 1907, and will always be remembered in this district for his work at times of explosions and big accidents at collieries in South Wales, for he invariably played a prominent part in rescue operations and inspired all by his fearlessness and courage.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Non-Unionism.

ABOUT 1500 men at the Markham Colliery, Tredegar Valley, are idle as the result of the non-unionist campaign. It is reported that only 10 per cent. are outside the Federation.

Swansea Dock Facilities.

As the result of representations made by the Swansea Chamber of Commerce, the Great Western Railway Company has arranged to put on six extra gangs of tippers, which will enable three tips to be worked in sixteen hours at the North and (or) South Docks. This means an increase of 25 per cent. tipping capacity as regards the Great Western Railway, and will relieve considerably the congestion as far as the smaller steamers at the King's and Prince of Wales docks are concerned.

CATALOGUES.

DANIEL ADAMSON AND CO., Limited, Engineering Works, Dukinfield.—A leaflet which describes and illustrates the "Adamson" superheater.

MARSHALL, SONS AND CO., Limited, Gainsborough.—The following publications have been received:—No. 1301, boilers of the Cornish and Lancashire types; No. 1302, the Marshall method of boiler construction; No. 1304, the Marshall water cart; No. 1306, the Marshall "Locomobile" engines; No. 1307, sectional catalogue of portable steam engines and other machinery suitable for public works contractors, builders and others.

CONTRACTS.

WILLIAM BEARDMORE AND CO., Limited, have received an order for 3358 pairs of wheels and axles for the East Indian Railway Company. This contract is valued at over £130,000.

HOLLINGS AND GUEST, Limited, of Birmingham, have received from the Birmingham Corporation salvage department orders for the supply of an hydraulic scrap-bundling press and of the motor-driven hydraulic pumps for working it at the Lifford depôt; and also for the supply of an hydraulic paper-baling press, a scrap-metal bundling press, and two sets of motor-driven pumps and hydraulic accumulator for the Brookvale salvage depôt, Birmingham. The same firm has also been successful in obtaining the contract for the supply of a sludge pump for the Saltley depôt of the Birmingham and District Tame and Rea Drainage Board

THE INSTITUTION OF LOCOMOTIVE ENGINEERS.—The annual dinner of the Institution of Locomotive Engineers was held at the Engineers' Club, Coventry-street, on Friday last, with Mr. Robert Whitelegg, President, in the chair. There was an excellent attendance. Colonel Kitson Clark proposed the health of "The Guests" in an admirable speech, with a very pleasant literary flavour, and to it Sir Charles Morgan replied. Then Mr. Walter Chalmers gave the toast of "The Technical Press," which was acknowledged by Mr. Loughnan Pendred. The last toast was that of "The Institution," which was submitted by Major A. W. Szlumper. In replying to it, the President stated that the membership of the Institution amounted now to about twelve hundred, and it looked forward to being, some day, housed in a building of its own. He expressed the hope that the chief mechanical engineers would "recognise" the Institution, and he suggested that both they and the heads of the big locomotive building firms should give it some financial support. An excellent musical programme was given during the evening.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	22/6
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	25/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	6 7 6	—
No. 1 Foundry	6 5 0	—
No. 3 Foundry	6 0 0	—
N.E. Coast—		
Hematite Mixed Nos.	6 7 6	6 7 6
No. 1	6 8 6	6 8 6
Cleveland—		
No. 1	6 10 0	6 10 0
Silicious Iron	6 10 0	6 10 0
No. 3 G.M.B.	6 7 6	6 7 6
No. 4 Foundry	6 5 0	6 5 0
No. 4 Forge	6 0 0	6 0 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge *	—	—
" " Foundry	5 12 6 to 5 15 0	
(3) Northampton—		
Foundry No. 3 *	—	—
" Forge *	—	—
(3) Derbyshire—		
No. 3 Foundry	5 7 0 to 5 10 0	
Forge	5 0 0 to 5 5 0	
(3) Lincolnshire—		
Basic (non-offering)	6 0 0 to 6 10 0	
Foundry	5 10 0	—
Forge	5 5 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	6 17 6	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best "	—	—
N.E. Coast—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
Lancs.—		
Crown Bars	12 10 0	—
Second Quality Bars	11 15 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	12 10 0	—
Best "	13 10 0	—
Hoops	15 10 0	—
Midlands—		
Crown Bars	12 10 0	—
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	11 10 0 to 11 15 0	
Gas Tube Strip	12 10 0	—

STEEL

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates ⅜in. and up	9 15 0	-
Sections	9 5 0	—
Steel Sheets ¼in. to ½in.	12 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	19 5 0

STEEL (continued)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	14 0 0	—
Joists	10 0 0	—
Heavy Rails	10 10 0	—
Fish-plates	14 10 0	—
Channels	9 5 0	—
Hard Billets	10 15 0	—
Soft Billets	10 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 10 0	—
Light "	11 0 0	—
Billets	10 0 0	—
Manchester—		
Bars (Round)	12 0 0	—
" (others)	10 15 0 to 11 0 0	
Hoops (Best)	15 5 0	15 0 0
" (Soft Steel)	13 15 0	13 10 0
Plates	11 0 0 to 11 10 0	
" (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	13 0 0	—
Bessemer Billets	13 10 0	—
Hard Basic	10 15 0	—
Intermediate Basic	10 10 0	—
Soft Basic	10 0 0	—
Hoops	12 15 0 to 13 5 0	
Soft Wire Rods	13 0 0 to 13 10 0	
Midlands—		
Small Rolled Bars	11 0 0	—
Billets and Sheet-bars	9 5 0 to 9 15 0	
Gas Tube Strip	12 0 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	19 10 0 to 20 0 0	
Angles	10 5 0	—
Joists	10 5 0	—
Tees	11 5 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	27/- to 25 6
Block Tin (cash)	213 0 0
" (three months)	214 5 0
Copper (cash)	73 5 0
" (three months)	74 2 6
Spanish Lead (cash)	27 15 0
" (three months)	27 17 6
Spelter (cash)	35 5 0
" (three months)	35 7 6
Manchester—	
Copper, Best Selected Ingots	78 0 0
" Electrolytic	83 0 0
" Strong Sheets	106 0 0
" Loco Tubes	0 1 2½
Brass Loco Tubes	0 1 1
" Condenser	0 1 2½
Lead, English	30 0 0
" Foreign	29 0 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23	10/6
" 6 p.c. to 8 p.c. "	£21 0 0	8/-
" 8 p.c. to 10 p.c. "	£20 0 0	8/-
" Specially Refined		
" Max. 2 p.c. carbon	£52 0 0	20/-
" " 1 p.c. "	£62 0 0	22/6
" " 0·75 p.c. carbon	£72 0 0	25/-
" carbon free	1/6 per lb.	
Metallic Chromium	4/6 per lb.	
Ferro Manganese (per ton)	£16 for home.	
" Silicon, 45 p.c. to 50 p.c.	£12 5 0 scale	5/- per unit
" " 75 p.c.	£20 0 0 scale	6/- per unit
" Vanadium	17/- per lb.	
" Molybdenum	9/6 per lb.	
" Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£130	
Cobalt	12/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	28/6
" " Ell	29/6
" " Splint	32/- to 35/-
" " Trebles	31/-
" " Doubles	30/6
" " Singles	30/-
Ayrshire—	
(f.o.b. Ports)—Steam	28/6
" " Splint	32/-
" " Trebles	31/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	31/- to 35/-
Screened Navigation	36/-
Trebles	31/6
Doubles	30/6
Singles	30/6
Lothians—	
(f.o.b. Leith)—Best Steam	32/6
Secondary Steam	30/6
Trebles	31/6
Doubles	31/-
Singles	30/6

ENGLAND.

(8) N.W. Coast—	
Steams	39/6
Household	46/8 to 57/6
Coke	42/6
Northumberland—	
Best Steams	33/6 to 35/-
Second Steams	30/- to 31/-
Steam Smalls	22/- to 25/-
Unscreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	33/- to 35/-
Second	32/6
Household	25/- to 28/-
Foundry Coke	77/6 to 80/-

Sheffield—	Inland.	
Best Hand-picked Branch	32/6 to 34/6	—
Barnsley Best Silkstone	28/- to 30/-	—
Derbyshire Best Brights	25/6 to 27/6	—
" " House	23/- to 24/6	—
" " Large Nuts	20/6 to 22/6	—
" " Small "	17/- to 19/-	—
Yorkshire Hards	22/- to 24/-	—
Derbyshire "	21/- to 24/-	—
Rough Slacks	11/- to 12/6	—
Nutty "	10/- to 12/-	—
Smalls	6 - to 8/-	—
Blast Furnace Coke (Inland and Export)		24/- to 30/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	37 6 to 40/-
Second " "	35/- to 37 6
Best Dry Large	34/- to 36/-
Ordinary Dry Large	32/6 to 33/6
Best Black Vein Large	35/- to 37/6
Western Valley "	34/- to 35/-
Best Eastern Valley Large	34/- to 35/-
Ordinary " "	31/- to 33/-
Best Steam Smalls	27/6 to 30/-
Ordinary "	25/- to 27/6
Washed Nuts	30/- to 32/6
No. 3 Rhondda Large	33/- to 35/-
" " Smalls	27/- to 28/-
No. 2 " Large	30/- to 32/-
" " Through	27/6 to 28/6
" " Smalls	23/- to 25/-
Coke (export)	70/- to 80/-
Patent Fuel	40/- to 47 6
Pitwood (ex ship)	27/- to 27/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	40/- to 45/-
Seconds	35/- to 40/-
Red Vein	30/- to 32/6
Machine-made Cobbles	45/- to 50/-
Nuts	45/- to 50/-
Beans	45/- to 47/6
Peas	20/- to 23/-
Breaker Duff	12/- to 13/-
Rubbly Culm	15,6 to 16/-
Steam Coals:	
Large	28/- to 30/-
Seconds	26/- to 27/-
Smalls	17/- to 20/-
Cargo Through	23/- to 25/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b

* Quotations extremely high and nominal.

French Engineering Notes.

(From our Correspondent in Paris.)

A Better Outlook.

THE seizure of the stocks of coke in the Ruhr having permitted of increasingly large consignments being sent to this country, and the supplies from Belgium and Czecho-Slovakia being more regular, the situation of the blast-furnaces has greatly improved, to the extent that the crisis appears to have passed and to have left an impression that the iron and steel trades have entered upon a period of recovery. There has, at all events, been a check to the inflation of prices, and now that a number of blast-furnaces are working normally the reasons that induced merchants to hold back stocks of rolled iron no longer exist, and it is much easier to obtain supplies. All this, of course, depends upon the situation in the Ruhr continuing without further complications. A particularly satisfactory feature is the amount of business being transacted in the engineering trades. The high prices have not checked the placing of new orders, and there is so much work to be done that ample employment seems to be assured so long as raw material is obtainable. The production costs are probably higher than they have ever been before. While the values of materials have largely increased, and have in many cases more than doubled in a few weeks, the further depreciation of the franc created an agitation for higher wages, and it will no doubt be found that manufacturing costs are now greater than they are in Britain. So far as industrial reconstruction is concerned, there is plenty of activity, but all other enterprise in the devastated areas is at a standstill, owing to the impossibility of the State making any further advance upon reparations due from Germany.

Commercial Arrangements.

The efforts of the French Government to extend the system of short period commercial treaties, which have already been signed with Czecho-Slovakia, Poland and Spain, are meeting with serious difficulties from Belgium, where negotiations that have been carried on intermittently for two years past are still far from reaching a satisfactory issue. As Belgium has always adhered to Free Trade principles, it was unable to offer advantages in the way of reciprocal treatment in return for concessions from France, and while the French Government is tied down by the necessity of protecting home industries, it was hopeless to expect to do anything in favour of Belgium so long as the importations from that country competed with French productions. The only way open to Belgium was, therefore, to embark boldly upon a protectionist policy which would enable it to treat on a basis of fair reciprocity. The Government of that country has now introduced a Bill providing for a considerable increase in the duties upon imported goods. On machine tools, for example, it is proposed to put up the duty to 160 francs per 100 kilos., the tariff diminishing with the weight of the machines. The Belgians are of the opinion that no arrangement is possible with foreign countries except on the basis of facilitating business in the specialities of each, that is to say, the Belgian Government is prepared to import French special productions on condition of France applying a favourable tariff to Belgian manufactures. Under the proposed new tariff French goods will be practically shut out of the Belgian market altogether unless the Government of this country consents to differentiate between specialities, such as wines, silks, chemical products, agricultural produce and the like, and machinery and other manufactured goods which can only be imported into the country under conditions which will place Belgian firms on competitive terms with French manufacturers. The French Government is trying to find a way out of the difficulty by arranging conferences between French and Belgian makers. The proposed new tariffs in Belgium provide, for example, for the trebling of duties on motor cars. The motor car firms in both countries are, therefore, to meet and discuss the situation, and if a satisfactory arrangement can be come to it is probable that meetings will take place between representatives of other industries with a view of arriving at a compromise that will give satisfaction to all concerned.

Mechanical Coal Getters.

At the annual meeting of the Comité Central des Houillères de France a particularly interesting review of the condition of the coal trade last year was presented by the chairman, M. Darcy, who spoke highly of the remarkable results obtained by British coalowners in recapturing the world's markets in face of great difficulties. Much, he said, had already been done by the French colliery industry in bringing down the cost of coal production and that, too, at a time when there was a diminution of 24 per cent. in the output per man as compared with the pre-war figures. As a justification for shorter working hours and higher wages, it is often affirmed that the companies do not take full advantage of mechanical coal extraction, but M. Darcy pointed out that owing to the irregular character of the seams and their thinness it was rarely possible to employ coal-cutting machines, the collieries constituting, in fact, a considerable number of small workings, where the coal could only be got by manual labour. Nevertheless, wherever possible mechanical means were employed, and while in one colliery the number of perforators had increased from 21 in 1914 to 558 in 1922, in another the proportion of coal brought down mechanically was 55 per cent. In view of the labour restrictions the companies are only too anxious to employ machinery wherever possible, and unless some relief can be secured from the rigid legislation affecting working hours, it is probable that, in order to obtain a satisfactory output, coal mining machinery will have to be used more extensively, even though it has to be employed in conditions in which it would not appear, as far as can at present be seen, to offer an advantage.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

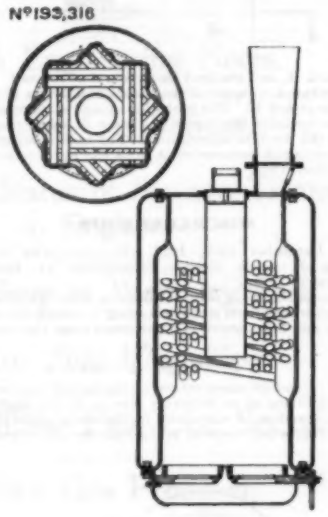
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

193,316. April 12th, 1922.—VERTICAL BOILERS, Mann's Patent Steam Cart and Wagon Company, Limited, and J. H. Mann, Pepper-road, Hunslet, Leeds.

IN this boiler, the tube plates are arranged in such a manner as to leave a space for the central firing tube without materially reducing the number of the water tubes. The tube plate portion of the circular flue is made to a cross section of star formation,

N°193,316



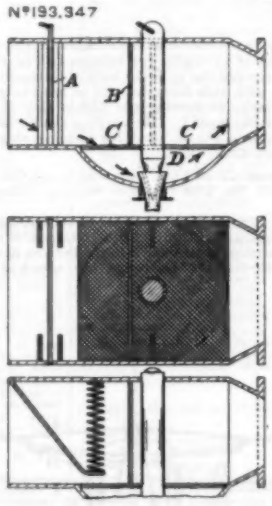
produced by the intersection of the sides of two squares, having their axes at an angle of 45 deg. to one another, whereby the interrupted tube plates so formed cause the cross water-tubes to leave a space for the passage of the central firing tube, while the fire-box is of a form capable of withstanding considerable external pressure.—*February 22nd*, 1923.

INTERNAL COMBUSTION ENGINES.

193,347. July 27th, 1922.—CARBURETTERS, E. W. Wynne, 35, South John-street, Liverpool, and R. H. Anderson, 35, South John-street, Liverpool.

In this carburetter the air drawn in by the engine is deflected downward by the shutter A. As it cannot pass the diaphragm B

N°193,347



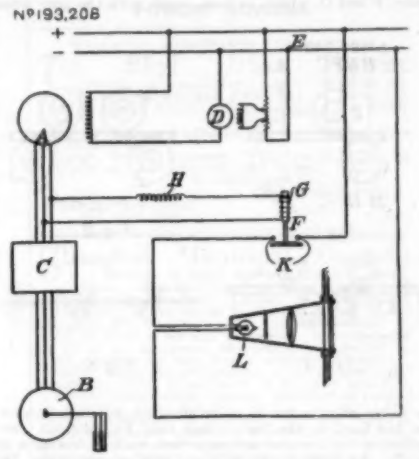
it passes downward through the grid C, past the fuel jet D, up again through the grid and thence to the outlet. Both the shutter and jet are capable of adjustment.—*February 22nd*, 1923.

DYNAMOS AND MOTORS.

193,208. December 22nd, 1921.—IMPROVEMENTS RELATING TO INDICATING DEVICES FOR USE WITH ALTERNATING-CURRENT ELECTRIC GENERATORS DRIVING INDUCTION MOTORS, Allen Bertram Field, of Kingslea, Marple, Chester, Leonard Millar, of 8, St. Anne's-road, Chorlton-cum-Hardy, and the Metropolitan-Vickers Electrical Company, 4, Central-buildings, Westminster.

When induction motors are driven from alternating-current generators certain conditions may arise which call for considerable over-excitation. In marine propulsion, for example, where the propellers are driven by induction motors, these conditions will arise when the propellers are being reversed. This over-excitation can be permitted for a short space of time, but if it is maintained for too long a period, the field windings may overheat. The object of this invention is to provide a device for indicating to the operator that the condition of excitation has been maintained longer than necessary. When the conditions which demand over-excitation arise, the induction motor will take a large current at low power factor, and, consequently, when the generator fields are over-excited, the voltage generated will be much lower than it would be with the same excitation when running under normal conditions. Furthermore, as a certain amount of speed adjustment of the prime mover is effected, both under running conditions and when starting or reversing propellers, the frequency of the power supply to the induction motors is not constant, and therefore variations of generator voltage arise apart from changes in the excitation or in the motor slip. According to this invention, both of these factors are taken into account, the indicating device being adapted to depend on the generator voltage divided by the frequency of the current flowing between the generator and motor, and therefore to indicate high excitation, no matter what the voltage or frequency may be, after this excitation has been

N°193,208



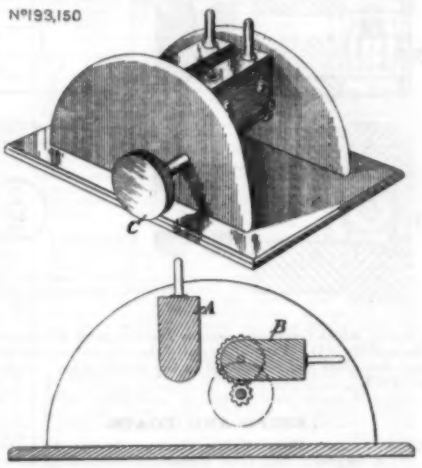
maintained long enough for the slip to come down to normal value. An alternating-current electric generator A is arranged to supply an induction electric motor B with three-phase alternating current, suitable control apparatus being indicated by the rectangle C. The generator is excited by a direct-current machine D, which has its terminals connected to an auxiliary circuit E. The indicating device comprises a relay F, the actuating coil G of which is connected in series with an inductive resistance H across two of the phase conductors. The contacts of the relay K are adapted when closed to connect a signal lamp L to the auxiliary circuit E, so that a window in the switchboard is illuminated.—*February 22nd*, 1923.

TELEGRAPHS AND TELEPHONES.

193,150. November 18th, 1921.—IMPROVEMENTS IN OR RELATING TO VARIABLE INDUCTANCE DEVICES, Walter Witt Burnham, of St. Paul's Wharf, Deptford, S.E. 8.

The variable inductance device described in this specification is particularly applicable to tuning coils for use in wireless telephony. The holders for supporting the fixed and movable coils

N°193,150



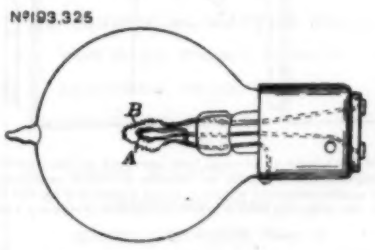
are shown at A and B respectively, the latter being geared to a milled head C, so that by turning this member the distance between the coils is varied. A three-coil coil holder, constructed on the same principle, is also illustrated.—*February 19th*, 1923.

LIGHTING AND HEATING.

193,325. May 3rd, 1922.—IMPROVEMENTS IN AND RELATING TO ELECTRIC LAMPS, *The British Thomson-Houston Company, Limited, of Crown House, Aldwych, W.C. 2.*

The object of this invention is to combine an incandescent electric lamp of the type having two or more concentrated filaments A and B with a reflector, the filaments being so arranged that when one filament of the lamp is focussed in a signal lamp

N°193,325



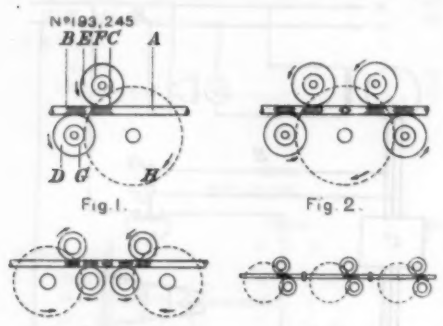
or a headlight having a reflector, or in any similar device, all of the filaments will be equally in focus, and, consequently, the light from any one of the filaments will be projected and will be distributed in substantially the same way as the light from any other filament of the lamp. The filaments are made as con-

centrated as possible, and have a length which is suitable for giving the desired beam of light. The two filaments may be of unequal candle-power, and by operating a switch either filament may be brought into use.—*February 22nd*, 1923.

TRANSMISSION OF POWER.

193,245. January 24th, 1922.—Worm Gear, W. L. Spence, 1, Avenue-road, Wolverhampton.

In this gear the inventor aims at eliminating end thrust in the worm shaft. Two worms B and C of opposite hand are cut on the shaft A and mesh with two worm wheels D and E arranged on opposite sides of the shaft. The worm wheels are keyed to pinions F and G, which, in turn, mesh with the gear wheel H.

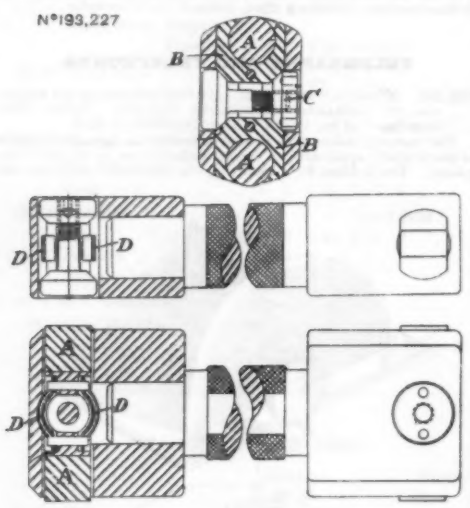


The worm shaft is free to move endways, to a small extent, so that the load on the two worms may be balanced. Several applications of the gear are suggested, such as driving a winch, Fig. 2; the ends of two adjacent mining conveyors, Fig. 3; and locomotive driving wheels, Fig. 4.—*February 22nd*, 1923.

MEASURING AND TESTING INSTRUMENTS.

193,227. January 9th, 1922.—Gauges, W. Wright, 54, Friars Stile-road, Richmond Hill, Richmond, Surrey.

In this adjustable gauge the actual gauging is effected between the two cylinders A A, which protrude slightly from their carriers B B. Adjustments can be made by means of the coned bolt

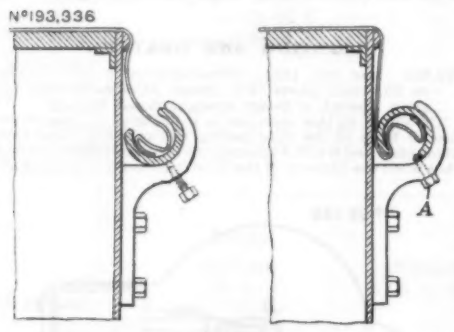


and nut C, which forces the carriers apart against the resistance of the springs D D. A modification of the idea for outside gauges is also described and illustrated in the specification.—*February 22nd*, 1923.

SHIPS AND BOATS.

193,336. June 20th, 1922.—Hatch Cover Fastenings, *A. J. Stephens*, 285, *High Holborn, London, W.C.* 1.

This device is intended for securing the tarpaulins stretched over the hatches of vessels when they are at sea. It takes the form of an open-sided pipe, as shown in the illustration, into which the edge of the tarpaulin is tucked. The pipe is then

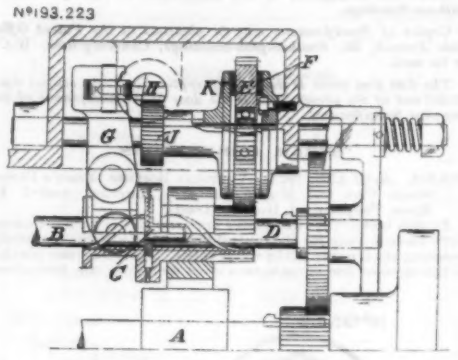


rotated by means of turning bars inserted in holes provided for the purpose, and held by set screws A. In a modification the pipe is made excentric where it is not embraced by the bearings, so that the gripping action is accentuated.—*February 22nd*, 1923

MACHINE TOOLS AND SHOP APPLIANCES.

193,223. January 7th, 1922.—Feed Gear for Planing Machines, C. F. Shanks, Union Ironworks, Johnstone, Renfrewshire.

In this feed gear A is the driving shaft, which alternately rotates in opposite directions. B is the shaft connected with the feed gear. A toothed clutch C is mounted on a shaft D by means of a helical feather, and meshes with the ring E. The rotation of E is checked by the friction brake F. As A rotates, it drives D, and the clutch C is pushed along the feather on account of the drag of the brake F. The two parts of the clutch C are kept together by the lever G, the top end of which bears against the



side of a rack H, and the feed shaft B is thus rotated. The ring E is then rotated, in spite of the brake, and drives the pinion J through the clutch K. The rack H is moved along until a notch in it comes opposite the top of the lever G, when the clutch C opens and the drive is interrupted. The rack is returned to its original position on reversal of A, and the cycle is repeated.—*February 22nd*, 1923.

MISCELLANEOUS.

193,214. December 28th, 1921.—Manufacture of Piston Rings, J. A. R. Bennet, Sturegatan 41, Landskrona, Sweden.

The principal claim in this specification is for :—"The method of manufacturing piston rings according to which the conformation of the mid line thereof is determined from the formula—

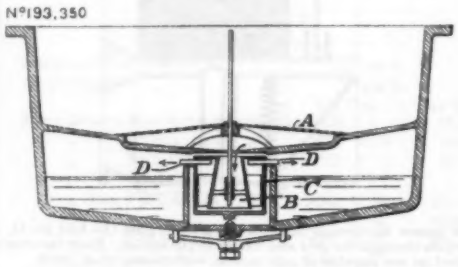
$$r_1 = \frac{r^2}{r - 12\,p r^2\,(1 + \cos\phi)\,a}$$

wherein r^1 = radius of curvature of the middle line of the ring before its splitting in an arbitrary section at the angle ϕ at the centre; r = radius of curvature at the same place of the mid line of the ring when inserted in the cylinder; a = radial thick-

ness of the ring; a = coefficient of elongation, *i.e.*, the reciprocal of the modulus of elasticity for tension of the ring material; p = pressure against the cylinder wall." A template A is made in accordance with this formula, and is used to guide the tool carriage of a lathe in turning the piston ring B, through the intervention of the lever C. By varying the proportions of this lever, one template can be used for forming rings of different sizes.—*February 22nd*, 1923.

193,350.—August 29th, 1922.—Centrifugal Oil Separators, L. Renault, 15, Rue Gustave Sandoz, Billancourt, Seine, France.

The inventor proposes to use a small centrifugal machine for removing foreign matter from the lubricating oil of motor engines. The oil is led through a strainer A in the bottom of the crank case into the conical rotor B of the centrifuge, which is driven off the



crank shaft. The foreign matter in the oil, being heavier, is thrown to the side of the casing C, while the oil escapes by the pipes D D, and is returned to the lubricating system. No mention is made of means for removing the accumulated rubbish from the casing C.—*February 22nd*, 1923.

173,233. December 21st, 1921.—Improvements in Cores for Electro-magnets, *Western Electric Company, Limited, Norfolk House, Victoria Embankment, Westminster, W.C.* 2.

This invention relates to magnet cores, and particularly to telephone loading coil cores of the so-called "dust" type. The general object of the invention is to provide a magnet core of iron and nickel, wherein the nickel content is more than 25 per cent. of the whole, which is cheap to manufacture and possesses to a high degree those characteristics which are desirable for cores for loading coils and other electrical apparatus. An alloy is obtained in finely divided form by heating a mixture in finely divided form of the metals which are to compose the alloy, to a temperature high enough to cause alloying, the resulting product being then ground up, coated with insulating material, and formed into a solid in the usual manner. It is first necessary to obtain a mixture in finely divided form and in the proportions desired in the alloy, of iron and nickel. Suitable proportions are approximately 78 per cent. nickel and 22 per cent. iron. A cheap and satisfactory manner of obtaining an intimate mixture of iron and nickel in finely divided form is to deposit these metals in the desired proportions in an electrolytic bath from a solution of their salts. The deposited mixture thus obtained is then ground up into particles of the desired size. A mass of these particles is then heated to a temperature at which alloying takes place, care being taken not to raise the material to a temperature at which the constituents fuse. The alloy thus obtained is in the form of a sintered mass, which is easily ground up into alloy particles. The alloy particles so obtained, may be sorted by sifting, coated with insulating material, and formed into a solid mass in the usual manner.—*February 22nd*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

FRIDAY, APRIL 6TH.

Junior Institution of Engineers.—Cannon-street Hotel, E.C. 4. Annual dance. 6.30 p.m.

Institute of Marine Engineers.—85–88, The Minories, Tower-hill, E. 1. Annual meeting. 6 p.m.

WEDNESDAY TO SATURDAY, APRIL 11TH TO 14TH.

Women's Engineering Society.—The University, Edgbaston, Birmingham. Annual conference.

FRIDAY, APRIL 13TH.

Diesel Engine Users' Association.—19, Cadogan-gardens, S.W. 3. "The Use of Cooling Water for Diesel Engines," by Mr. J. G. Griffin. Non-members can obtain tickets of admission from the secretary. 3 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Paper, "Instrument Equipment of Aeroplanes," by Mr. C. B. Clapham. 7.30 p.m.

TUESDAY, APRIL 17TH.

Institute of Marine Engineers.—85–88, The Minories, Tower-hill, E. 1. "The Operation of Water-tube Boilers for Cargo and Passenger Ships," by Mr. R. Clark. 6.30 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Automotive Products Company informs us that it has been appointed sole representative for Borg and Beck clutches, Lavine steering gears and Oakes fans.

Mr. George Cawley, of 82, Victoria-street, S.W. 1, who has practised as a consulting engineer in Westminster for the last thirty years, informs us that he is now retiring from business.

With reference to the recent notice of the appointment of receiver and manager over Alldays and Onions, Limited, Birmingham, we are asked to state that this has made no difference in the carrying on of the business or the output of goods.

Brims and Co., Limited, of Pandon Buildings, Newcastle-on-Tyne, inform us that they have moved their London office from Eaton Chambers, 50, Buckingham Palace-road, to Abbey House, Victoria-street, Westminster, S.W. Their telephone number remains as before, Victoria 135.

J. Whittall and Co., Limited, inform us that they have moved their offices from 9, Fenchurch-avenue, London, E.C. 3, to St. Stephen's House, Victoria Embankment, Westminster, S.W. 1, (immediately adjoining Westminster Station, Underground Railways.) New telephone number, Victoria 9865–6, and new telegraphic address, Bosman, Parl, London.

We are informed by Aerostyle, Limited, that having completed arrangements to purchase the plant and stock-in-trade of the Airostyle and Lithos, Limited, it is proposing to carry on the business on the same lines as were pursued by that firm at 35, St. Bride-street, Ludgate-circus, London, E.C. 4. Mr. F. E. Webb will be managing director and Mr. M. A. Rich, secretary of the company.

LAUNCHES AND TRIAL TRIPS.

Dumana, twin-screw motor vessel; built by Barclay, Curle and Co., Limited; to the order of the British India Steam Navigation Company, Limited; dimensions, 464ft. by 58ft. 3in. by 35ft. 6in.; 8500 gross tonnage. Engines, four-stroke single-acting Diesel; constructed by North British Diesel Engine Works, Limited; trial trip, March 17th.

Glenbuckie, single screw steamer; built by Swan, Hunter and Wigham Richardson, Limited; to the order of the Canadian Lakes Service; dimensions, 252ft. by 42½ft. by 20½ft. Engines, inverted marine type with three cranks, pressure 180 lb.; constructed by Hawthorn, Leslie and Co., Limited; launch, March 20th.

Torr Head, steamship; built by Workman, Clark and Co., Limited; to the order of the Ulster Steamship Company; dimensions, 413ft. long; 5200 gross tonnage. Engines, single-screw tripe-expansion; constructed by the builders; launch, March 20th.

Hopper Barge; built by Cammell Laird and Co., Limited; to the order of the Mersey Docks and Harbour Board; dimensions, 207ft. by 35ft. 6in. by 16ft. 3in. Engines, triple-expansion, constructed by the builders; launch, March 21st.

Minnewaska, passenger liner; built by Harland and Wolff, Limited; to the order of the Atlantic Transport Company, Limited; dimensions, 625ft. by 80ft. by 53ft. 6in.; 21,400 gross tonnage. Engines, Brown-Curtis geared turbines, pressure 215 lb.; constructed by the builders; launch, March 22nd.

Oroya, twin-screw steamer; built by Harland and Wolff, Limited; to the order of the Pacific Steam Navigation Company; dimensions, 547ft. 6in. by 62ft. 6in. by 43ft. 6in.; 12,300 gross tonnage. Engines, two sets of Brown-Curtis geared turbines; constructed by the builders; trial trip, March 22nd.

Drechtdyk, twin-screw motor vessel; built by Harland and Wolff, Limited; to the order of the Holland-America Line; dimensions, 502ft. by 62ft. by 38ft. 6in.; 9500 gross tonnage. Engines, two eight-cylinder four-cycle Diesel oil, pressure 100 lb.; constructed by the builders; trial trip, March 22nd.

A Development of the Cyc-arc Welding Process.—We are asked to state, with reference to the article entitled "A Development of the 'Cyc-arc' Welding Process," which appeared in our last issue, that the firm of Handstock, Ltd., of Brookside Works, Wokingham, is the proprietor of the "Cyc-arc" patents, and that it manufactured the apparatus described in the article.